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INDIANA UNIVERSITY
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Bureau of Cooperative Research and Field Service
School of Education
Indiana University, Bloomington, Indiana

HENRY LESTER SMITH, Director
MERRILL T. EATON, Assistant Director

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BULLETIN OF THE SCHOOL OF EDUCATION
INDIANA UNIVERSITY

An Analysis of Arithmetic Textbooks (First Period—1790 to 1820)

by

HENRY LESTER SMITH

and

MERRILL THOMAS EATON

A List of Bulletins in the Field of Education, Indiana University

by

KATHLEEN DUGDALE

INDIANA UNIVERSITY
EDUCATION
READING ROOM

Published by the
BUREAU OF COOPERATIVE RESEARCH
AND FIELD SERVICE
Indiana University

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An Analysis of Arithmetic Textbooks (First Period—1790-1820)

H. L. SMITH and M. T. EATON

INTRODUCTION

THE subject of the effectiveness of teaching arithmetic has caused much discussion recently. There is considerable feeling that the scope and method of presenting arithmetic content today do not give pupils a sufficient control and understanding of mathematical processes with which to cope satisfactorily with life situations requiring the use of these processes. Questions on what should be taught and when and how are commonly debated. Authors of arithmetic textbooks often disagree regarding the nature and scope of the content which should be presented to elementary school pupils, and have used various standards in the selection, organization, and presentation of these materials. Thus, it seems desirable that a study be made of the basic characteristics and trends in arithmetic textbooks of the past in order that recognized inadequacies of present texts may be remedied by means of a more scientific approach than the trial and error method.

In a preliminary statement relative to the qualifications of *Cocker's Arithmetick*, which was published in England in 1706, John Hawkins, publisher, says: "The Method is familiar and easie, discovering as well the Theorick as the Practick of that Necessary Art of *Vulgar Arithmetic*." Thus we see that early there was the recognition of the need for both the theoretical and the practical in an arithmetic text. The degree to which each of these has been emphasized has been the source of much discussion. Has there been a definite trend toward the practical in arithmetic, which gives the pupil experience with the type of problems he is going to meet in life? Does the trend seem to be toward preparation for adulthood with its problems, or toward presentation of facts in the language of pupil interest? Is the trend toward presenting a reflection of the period, a traditional picture of the past, or a preparation for the future? How have these trends been related to sociological, economic, historic, and other conditions in our environment? What has been the trend in the nature of content and in the emphasis on various aspects of it? Many facts must be known before a satisfactory arithmetic textbook standard can be evolved, and these can be discovered only by a detailed and quantitative analysis of a wide number of representative texts over a period of years. The present study is an attempt to make this type of comprehensive analytical survey of arithmetic textbooks written between 1706 and 1940.

REVIEW OF RELATED STUDIES

While similar surveys of a very general nature have been attempted in closely related subjects, very little of a definite nature has been

done which is pertinent to the problem of the detailed and systematic analysis of arithmetic problems over an extended period of time. Even less has been done in the way of studying the socio-economic content of written problems. These facts may be proof of a definite need and may indicate the importance to be attached to a study that will correct that deficiency.

Breslich[1] points out that arithmetic textbooks of the early nineteenth century are "essentially a study of rules, dogmatically stated, to be used in solving problems." In other words, instead of aiming specifically toward the development on the part of the student of a thorough understanding of mathematical concepts, the authors of these early books attempted largely to provide the bases for problem computation. He states also that Colburn's arithmetic (1821) is looked upon as the first example of a tendency toward the arithmetic textbook of today in which thought processes are emphasized. As is true with most innovations, however, the reform initiated by Colburn only gradually entered into subsequent publications. Breslich further suggests that a great number of the prominent topics found in early arithmetic texts are now obsolete and that the amount of arithmetic actually taught was small. Finally, he points out that in early texts "commercial topics were predominant, because the subject was studied largely for commercial purposes," and that considerable emphasis was given to vocational problems. Thus arithmetics of the early nineteenth century, he says, were "suited to the demands of the time as well as modern courses are adapted to present-day life."

Gertrude Mae Anderson[2] analyzed the written problems in six representative arithmetic texts from 1808 to 1930. The question may be raised as to whether the textbooks she chose were truly representative of the texts of any chronological period—especially the choice of the Colburn text as representative of the texts of the 1820's. In her conclusions, there is apparently serious disagreement with Breslich's report on the practicality of the problems in early arithmetics. She states[3] that "most of the problems in earlier texts were unreal, or artificial, and today we turn toward business, industry, and the home for real life problems in texts where there are whole sets of social relations involved . . . . " She also lays stress on the number of puzzle problems included in the early texts for the purpose of mental discipline, and states that in the present-day textbooks puzzle problems are omitted. She further calls attention to the fact that in earlier years the text content was taught as of primary importance and that today the content is considered secondary to the development of pupil understanding and independence in thinking. The point is made that problem situations in present-day arithmetics are more simple and that "obsolete matter is discarded, since the specialization developed in the last hundred years has made it unnecessary for the average individual to do the specialized figuring such as tare and tret, paint-

[1] Breslich, E. R. "One Hundred Years Ago." *Elementary School Journal* 25:664-74, May, 1925.

[2] Anderson, Gertrude Mae. *Written Problems in Arithmetic Textbooks, 1808-1930.* Master's thesis, School of Education, Boston University, Boston, 1933.

[3] *Ibid.*, p. 532.

ing, papering, square root, and cube root."[4] Likewise, the numbers used in problems have decreased in size because of "the difference in the emphasis in teaching arithmetic from the mental discipline idea to the real number met in everyday life."[5]

While almost all critics admit the evolutionary nature of the change in problem content, yet an insufficient amount of study and careful analysis has been done to come to any agreed-upon conclusions concerning the exact nature and amount of these changes. Such changes, of course, must take place as social, political, and economic conditions change. While in early textbooks writers find no such positive effort toward furnishing real life situations as is to be found in present textbooks, yet they do find evidence of the influence of economic and sociological environment on problem content. Analysis of problems in the light of this influence has been greatly neglected.

The purposes of the teaching of arithmetic are matters of much conjecture. Hedrick[6] says, "the teaching of mathematics for so-called mental discipline is not supported by sound psychological investigation, . . . that transfer of training even within the boundaries of mathematics itself is limited in scope." However, he points out that mathematical training is important in modern education, especially if the subject matter is adapted to individual and social needs. Schorling[7] says the contribution of mathematics "is to provide the future citizen with such information as will give the family maximum security for given income."

There is disagreement also in regard to the amount of space given to the application of rules and to the type of applications presented. Foster[8] says, "only as a student comes to appreciate the concrete uses to which mathematics can be put will he retain the facts and the acquired skills beyond graduation day," while Breed[9] says that "social usage alone is not regarded as a sufficient criterion for the selection of subject matter."

There is a consensus of opinion as to the existence of an ever-present and excessive traditional influence in the treatment of the subject of arithmetic.

The Education Policies Commission[10] states that the purposes of teaching arithmetic are the development of skill in the fundamental processes, and of "an appreciation of the cultural value of mathematics, and its usefulness as a mode of thinking and as a means of interpreting world affairs." It is stated that the skills emphasized should be those which are needed most by the average individual.

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[4] *Ibid.*, p. 549.

[5] *Ibid.*, p. 550.

[6] Hedrick, E. R. "The Contributions of Mathematics to General Education." *Mathematics Teacher* 33:3-9, January, 1940.

[7] Schorling, R. "Place of Mathematics in General Education." *School Science and Mathematics* 40:14-26, January, 1940.

[8] Foster, LeBaron R. "Nine out of Ten Like Consumer Credit Problems." *Mathematics Teacher* 33:51-5, February, 1940.

[9] Breed, F. S. "Our General Outlook on Mathematics." *Journal of Educational Research* 32:241-54, December, 1938.

[10] *The Purposes of Education in American Democracy.* Education Policies Commission, National Education Association of the United States and the American Association of School Administrators, Washington, D.C., 1938. p. 58.

Some other significant studies are *Some Facts Concerning Changes in the Content and Methods of Arithmetic*, written by F. H. Gorman as his Doctor's thesis at the University of Missouri in 1931, and *The Twenty-ninth Yearbook of the National Society for the Study of Education*. Each of these reports includes detailed lists of the items and variations of content found in twentieth-century arithmetics. The order and method of presentation of content are emphasized in each study. Neither attempts a quantitative space analysis.

PURPOSE AND PLAN OF THE STUDY

Though a few analyses of arithmetic textbooks have been made, none of them seem to be the result of a detailed quantitative analysis of a large number of textbooks published over a long period of time. It has been the purpose of the authors of this study to find, by means of a comparatively complete analysis of arithmetics, the general and specific trends in the preparation of such textbooks in order to discover the relation of the content of these books to the social and economic life characteristic of the period, the relative emphasis given to various aspects of content, the psychological approach, the purposes, and the scope. It is hoped and believed that such an analysis will serve as a basis for reconstruction of textbooks and courses of study so that they may more nearly meet the needs of youth and adults in American life.

As raw materials for the study, approximately 200 arithmetic textbooks were collected and arranged in order according to date. It was found desirable to determine this date (whenever possible) from that given at the end of the author's preface, since the date of printing (instead of the date of original publication) is often given on the title page of the older books. Although revised editions usually contain new prefaces with a clarification of the dates of first publication and of revision, the dates on the title pages of unrevised reprints sometimes vary as much as fifteen years or more.

In making such a study of textbooks, it is desirable to group the books into chronological periods, not only so that characteristics and trends within any short period can be studied, but also so that differences between textbooks published in different historical periods can be more easily observed. The periods used in this investigation are as follows:

1. Up to and including 1820
2. From 1821 to 1850, inclusive
3. From 1851 to 1880, inclusive
4. From 1881 to 1910, inclusive
5. From 1911 to 1940, inclusive

The books have been arranged so that Colburn's arithmetic, which has long been considered one of the most influential of the early textbook innovations with regard to method and approach, falls at the beginning of the second period. It so happens that America participated in a war at some time during each of the five periods. Thus national tension and economic recovery are general aspects which may influence the textbooks of each period.

GENERAL DESCRIPTION OF THE TEXTBOOKS USED

Eight textbooks published in the period up to and including 1820 are analyzed in this bulletin dealing with the first period of the study. These eight include:

1. Cocker, Edward. *Cocker's Arithmetick: Being a Plain and familiar Method, suitable to the meanest Capacity for the full understanding of that Incomparable Art, as it is now taught by the ablest School-Masters in City and Country.* Printed by Eben. Tracy, London, 1706.
2. Walkingame, Francis. *The Tutor's Assistant; Being a Compendium of Arithmetic, and a Complete Question-Book.* Printed by A. Millar, W. Law, and R. Cater, London, 1792; and Wilson, Spence and Mawman, York.
3. Pike, Nicolas. *A New and Complete System of Arithmetic. Composed for the Use of the Citizens of the United States.* Printed at the press of Isaiah Thomas, Worcester, Mass., 1797.
4. Gough, John. *Practical Arithmetick in Four Books . . . . Extracted from the larger entire treatise . . . and adapted to the Commerce of Ireland as well as that of Great Britain. For the use of schools.* Printed by W. Magee, Belfast, 1801.
5. Pike, Nicholas. *The New Complete System of Arithmetick. Composed for the Use of the Citizens of the United States.* Published by Thomas and Andrews, Boston, 1807.
6. Pike, S. *The Teachers' Assistant.* Published by Johnson and Warner, Philadelphia, 1811.
7. Watson, Thomas; Jaudon, Daniel; and Addington, Stephen. *The Youth's Arithmetical Guide: being a compendious System of Practical Questions in Arithmetic, designed for the instruction of youth.* Printed by David Hogan, Philadelphia, 1814.
8. Daboll, Nathan. *Daboll's Schoolmaster's Assistant: Improved and Enlarged; Being a Plain Practical System of Arithmetic: Adapted to the United States.* Printed by Thomas M. Skinner, Auburn, 1820.

The book by Cocker, according to the statement of the editor, was intended to treat only a part of the topics commonly taught in arithmetic. For this reason and for the additional reason that it was written more than 85 years before any other text analyzed in this study, it seemed advisable to treat it separately.

Cocker's Arithmetick is a small book, having only 215 numbered pages. The printed page measures approximately 3 by 5 inches. The type is relatively small and rather closely spaced, with very little blank space between topics of the book. The copy used for this analysis has a board binding but shows evidence of having been rebound at least once, as the margins are very narrow and irregular.

The preface of Cocker's text points out that the book was prepared first to serve the practical needs of those who need to use numbers, especially merchants, but that it was also intended to serve as a handbook for teachers, a textbook for youths, and a stimulating book

for numerists (those who deal with numbers without any direct practical goal).

In this book, which was published more than two and a quarter centuries ago, there are a number of marginal Latin quotations from still older mathematical treatises. Particularly noticeable is the extremely detailed manner in which the examples and explanations are given. A relatively high percentage of the written problems are solved and explained. Decimals and closely related topics are not included, since the author intended to treat this division of arithmetic in another book. Another unique feature of this book is a list of all the books sold by the stationer and, on the last page, an advertisement of a new balsam brought from Chili. This medicine was also sold by the stationer and was recommended as a cure-all for all ailments of the human body.

Of the other seven books published before 1820 and included in this study, one was published in England, one in Ireland, and five in the United States.

The earliest of these seven, *The Tutor's Assistant* by Walkingame, contains more material than its 180 pages would indicate, for the type is very small and there is very little blank space on its 3 by 5½ inches of printed surface on each page. The copy used in this analysis was bound in red split leather.

In the preface of the book which was published in England, the author attempts to present more concise rules and simpler explanations of method than those in earlier textbooks. The book is intended to serve as a time-saver for the teachers and for pupils, as pupils would otherwise have to await their turn in using copies set by the teacher on slates or papers and thus fail to make progress consistent with the time which they spent in school. The author points out that he has made a special effort to include applications and even several new topics to make the book especially applicable in real business, such as bills of parcels, the calculation of annuities, rents, incomes, and servants' wages.

An interesting feature of this book is the author's anticipation of criticisms against the preparation of such a book. The similarity between these and present-day criticisms of certain innovations in educational materials and methods is evident in the following excerpt from the preface of the text:

> And now, after all, it is possible that some who like best to tread the old beaten path, and to sweat at their business, when they may do it with pleasure, may start an objection against the use of this well-intended ASSISTANT, because the course of ARITHMETIC is always the same; and therefore say, *That some boys, lazily inclined, when they see another at work upon the same question, will be apt to make his operation pass for their own.* But these little forgeries are soon detected by the diligence of the Tutor: Therefore, as different questions to different boys do not in the least promote their improvement, so neither do the questions hinder it. Neither is it in the power of any master, (in the course of his business) how full of spirits soever he be, to frame new questions at pleasure, in any rule; but the same question will frequently occur in the same rule, notwithstanding his greatest care and skill to the contrary.

It may also be further objected, *That to teach by a printed book is an argument of ignorance and incapacity;* which is no less trifling than the former. He, indeed, (if any such there be) who is afraid his scholars will improve too fast, will undoubtedly decry this method: But that master's ignorance can never be brought in question who can begin and end it readily; and, most certainly, that scholar's non-improvement can be as little questioned, who makes a much greater progress by this than by the common method.

The author furthermore points out in the preface, "as to the rules, they follow in the same manner as the table of contents specifies, and much in the same order as they are generally taught in schools." Thus, this table of contents perhaps gives a reasonably accurate picture of the order of presentation of arithmetic units in that period. For that reason the order is quoted here:

Part I

Arithmetic in Whole Numbers

Introduction
Numeration
Integers Addition
————Subtraction
————Multiplication
————Division
Tables
Addition of several Denominations
————Subtraction
————Multiplication
————Division
Bills of Parcels
Reduction
Single Rule of Three Direct
———— Inverse
Double Rule of Three
Practice
Simple Interest
Commission
Purchasing of Stocks
Brokage
Compound Interest
Rebate or Discount
Equation of Payments
Barter
Profit and Loss
Fellowship
———— with Time
Alligation Medial
————Alternate
Position, or Rule of False
————Double
Exchange
Comparison of Weights and Measures
Conjoined Proportion
Progression Arithmetical
————Geometrical
Permutation

Part II

Vulgar Fractions

Reduction
Addition
Subtraction
Multiplication
Division
The Rule of Three Direct
———— Inverse
The Double Rule of Three

Part III

Decimals

Numeration
Addition
Subtraction
Multiplication
Contracted Multiplication
Division
————Contracted
Reduction
Decimal Tables of Coin, Weights, and Measures
The Rule of Three
Extract. of the Square Root
————Vulgar Fractions
A general Rule for extracting the Roots of all powers
Simple Interest
———— for Days
Annuities and Pensions, etc., in Arrears
Present Worth of Annuities
Annuities, etc., in Reversion
Rebate or Discount
Equation of Payments
Compound Interest
Annuities, etc., in Arrears
Present Worth of Annuities

——————Mixed Numbers
Extraction of the Cube Root
——————Vulgar Fractions
——————Mixed Numbers
——————Biquadrate Root
Annuities, etc., in Reversion
Purchasing Freehold, or Real Estate
——————in Reversion
Rebate or Discount

Part IV

Duodecimals

Multiplication of Feet and Inches
Measuring by the Foot Square
Measuring by the Yard Square
Measuring by the Square of 100 feet
Measuring by the Rod
Multiplying several Figures by several, and the Operation in one Line only

Part V

Questions

A Collection of Questions set down promiscuously, for the greater Trial of the foregoing rules
A general Table for calculating Interests, Rents, Incomes and Servants Wages

The order and nature of the contents of the remaining books of this 30-year period from 1791 to 1820 seem to vary little from this outline.

It is interesting to note that in Walkingame's book, the Latin verb *facit* is frequently used instead of *answer*. As is characteristic of most of the books in the period, the answers are included along with the problems.

Nicolas Pike's *A New and Complete System of Arithmetic*, a large book in comparison with others of the period, was published originally about 1785 and revised in 1797. The book is bound in brown cowhide and the 516 pages look heavy, as the printed page (3¾ by 6¼ inches) is larger than average at that time and the type is very small.

The preface of the book contains a statement that it is an attempt to devise a system of arithmetic more suitable than others to the needs of the United States, which had by that time become an independent nation. The author states that he has attempted to supply a greater number of illustrations and applications of rules than are found in other textbooks of the time. The text was prepared to serve as a basis for work from the lower classes to the university level, but the preface points out that it is better suited to the secondary school and college. Of course, the secondary school at that early date was not comparable with our high schools today.

The book contains a large number of footnotes which give theorems, further examples, and supplementary explanations. Detailed explanations of rules and of examples are particularly noticeable. Quite large sections of the book are given to geometry, algebra, trigonometry, conic sections, mensuration of surfaces, and chronological problems.

John Gough's *Practical Arithmetic* was prepared from a larger treatise, and intended for the use of schoolboys in Ireland. The book contains 348 numbered pages, each containing approximately 3 by 5½ inches of printed matter. The type is very small, and many of the

pages contain blank spaces, especially around examples. The copy used for the analysis is bound in brown cowhide.

The author points out that the method which he had in mind while preparing the textbook "was partly suggested by a Note on *Rollin's* Thoughts concerning Education." He quotes from the preface of this work:

> Arithmetic might be taught in Schools, in a much more expeditious Way than it generally is, by dividing the Scholars into Forms, in the same Manner as in teaching Languages, the Whole may be divided into five, six or more Classes: Ten of the Pupils, for instance, may be in Multiplication, Six in the Rule of Three, Thirteen in Practice, and so on. Whenever any Class is to proceed to a new Rule, the master may explain to them in chalk on two large boards, or some such Thing, the Nature and Genius of the Rules into which they are entering. A considerable Time should be employed in these Explications, and the Scholars might take Places, as in learning Latin, etc., which could not fail of inspiring them with great Emulation. The several Pupils in a Form should always be set the same Sum or Question, but must be separated to prevent their copying one from another. 'Twould also be proper to draw up for their Use, an Epitome of Arithmetick, by way of Question and Answer, containing the Nature and Explanation of the several Rules in that Science, this they should copy, and learn by heart perfectly; by which Means they would be able, not only to state their several Questions very expeditiously, but to give a Reason for every Thing.

The author of this text further points out that "the usual Method of Teaching Arithmetick is two-fold, either the Master or Assistant writes down the Rules and Questions for the Boys, or causeth them to write them themselves from printed Books or Manuscripts." He says there is a great deal of waste of time in such procedure which can be saved by having a textbook for each pupil. He emphasizes the need for the questions and answers, and actually includes lists of them throughout the book. In this connection, he says that, in the absence of suitable texts, teachers often make out lists of such questions and answers on the several rules of arithmetic in little manuscripts or on a sheet or two of paper for distribution to the pupils. He evidently did not think that his book presented the subject in the only way advisable, for he suggests that the parts of the book need not necessarily be taught in the order in which they are listed.

Gough's textbook is the only other book in this first division which contains any algebra, and here the subject is included as an appendix. A relatively large portion of the book is formed so as to be especially applicable in commercial relations. This can be understood, since the British Isles, of which Ireland is a part, is a maritime power.

The New Complete System of Arithmetick, by Nicholas Pike, is really an abbreviated and revised form of the 1797 textbook by the same author. The content is practically the same except that it is simpler and more concise. Algebra, geometry, trigonometry, mensuration of surfaces, conic sections, and a few other more complex or advanced units of mathematics are omitted. The book includes no preface. It is bound in brown cowhide and contains 252 numbered

pages of relatively small type. Each page contains about 3 by 5 inches of printed matter. The spacing between sections and items is relatively wide, thus leaving a great deal of blank space between printed matter on many of the pages.

S. Pike's *Teachers' Assistant* also, according to the preface, is concerned with the problem of simplification of materials. This is pointed out in the statement of its purpose:

> The design . . . is to furnish the several rules of Arithmetic concisely expressed, together with a variety of applicative examples, arranged in such order, that the learner may advance by gradations, from what is simple to what is more abstruse, and be unobstructed in his progress by ignorance of particulars that he should previously have known.

The arrangement of some of the tables, especially of the multiplication table, which more nearly resembles present-day form, is different from that of other textbooks. The arithmetic of business receives a great deal of emphasis, special emphasis being placed on federal money. The decimal point is represented by the period instead of the comma, which is used in some of the other textbooks. The term "application" is used to indicate written problems.

On the whole, this textbook approaches closely the author's goal of clearness and conciseness. Rules, examples, and other topics are clearly marked and explained without a great amount of extra detailed material. The book contains 198 numbered pages, each containing approximately 3 by 5½ inches of printed space. The print is not exceedingly small and the spacing is sufficiently large to make reading relatively easy. The copy used for this analysis had apparently been rebound in a board cover and had had repair work done on it since that time.

The Youth's Arithmetical Guide, according to its authors, Watson, Jaudon, and Addington, is based upon the assumptions:

> 1. That the proper business of arithmetic is, not to find results already known, but to discover those which are unknown.
> 2. That having the answer given, serves in some measure, as a guide and operates to the disadvantage of the learner, in every rule; more particularly in the rules of proportion, where by the aid it affords in making the statement, and finding the result, it prevents that careful examination, which is so essential to a clear and profitable understanding of the question.
> 3. That pupils accustomed to work such questions only, as have the answers given, seem utterly at a loss when desired to work those to which they are not given.
>
> And that learners, by having answers annexed to the questions, are often enabled (perhaps tempted) to impose upon their teachers, and thus wrong themselves, by exhibiting true results without having fairly obtained them.

The authors point out that, heretofore, in order to avoid these weaknesses of textbooks, they had depended upon the "setting" of manuscript questions for the pupils. Since that was a laborious and time-consuming process, the authors prepared this book containing questions and problems without answers for pupil use. A

few copies were printed with the answers, however, for use by the teachers; and it was possible to obtain either edition for the pupils. It so happens that the teacher edition is the only one available for this analysis. Perhaps in studying the results from the pupil viewpoint, then, all space given in this book to "problems with answers" should be transferred to the heading "drill" or "written problems without answers."

A further interesting feature of the book is that federal money is taught as a phase of compound denominate numbers (dollars, cents, and mills) in the forepart of the book, but that dollars and cents are not treated as decimals until after a general discussion of decimals has been presented at its usual position in textbooks.

This text contains 200 numbered pages, the printed matter of which covers approximately 3 by 5¼ inches of space. The type is relatively small, but is not so crowded as to make reading difficult. Several of the pages contain blank spaces between the various divisions of content.

Daboll's Schoolmaster's Assistant, published in 1820, is in reality a revised edition of a work written at least as early as 1799. The author states that he feels that the various existent systems of arithmetic were deficient in "the practical teacher's experience" in that they were "too sparing of examples, especially in the first rudiments." He attempts to correct this weakness by supplying such materials in his own text. He suggests that, in order to hold the attention of pupils, it is advisable to provide "a variety of easy and familiar questions, which might serve to strengthen their minds as their studies become more arduous." He points out, further, that he has attempted to arrange the rules and their application in order from the simplest to the more difficult.

In this textbook, federal coin is introduced earlier (along with whole numbers) than the regular section on decimals, though it is treated as decimal and not as a compound denominate number. Very little space is given at first to vulgar (common) fractions and relatively much more space is given to decimals than in the other books of the period. The author cites as his reason for this division of space that decimals are "more simple, useful, and necessary, and soonest wanted in more useful branches of arithmetic. . . . " Vulgar fractions are then treated in detail after the principal mercantile rules have been learned, that is, near the end of the book.

The book contains 240 numbered pages, each containing 3 by 5¼ inches of printed material. The type is approximately as large as that found in newsprint and is relatively easy to read. This is the fourth of the group to be bound in brown cowhide.

A general survey of the books of this division reveals a similar order of arrangement of content, all based on the method of deduction. The general order of treatment of each topic is as follows: definition, rule with explanation, often a brief rule of proof, example with explanation, sometimes an example of proof, drill problems, and written problems. Another aspect indicating the psychology of that day was

the frequent use, in the statement of written problems, of such words as "I desire to know" and "I demand to know."

However, there is a lack of uniformity in use of some terms and signs. For example, in some of the books the period is used to set off thousands, millions, etc., in writing numbers while the comma is used to indicate a decimal point. In other texts present-day usage is found. Tables show a great deal of variation and are considerably different in form from the present-day set-up. The answer is usually but not always given at the end of each problem, especially of written problems.

Since many of the books have been mended and some even rebound, no positive statements can be made regarding margins and binding. The fact that several of the copies are still bound in leather indicates that this may have been a favorite material for binding textbooks during this period. Some of the books have been subjected to hard use and exposure to the elements and the pages are yellow with age, so that it is not possible to judge the quality of the paper used. In general, however, the paper, print, and binding probably represent the best, or nearly the best, available at the time of publication. The textbooks compare favorably with the best of other books, now extant, printed at these early dates. In the earliest books the old form of the "s" is used. The type varies in size, but in all books it is smaller and more closely spaced than in the general content of elementary arithmetics today. In so far as it is possible to estimate, the outer dimensions of most of the books were originally smaller than those of present-day school texts.

TECHNIQUE OF PROCEDURE

Before beginning the actual quantitative analysis of the specific textbooks used in this study, a tentative, composite outline was formed, made up of major topics likely to be found in arithmetics. This list was designed to serve as a general guide in the classification of items found in the textbooks studied. It was developed from the tables of contents of several representative textbooks published from 1706 to 1940, from an outline from a doctor's dissertation[11] on the content of arithmetics from 1907 to 1930, and from outlines of phases of arithmetic as given in the *Twenth-ninth Yearbook of the National Society for the Study of Education.*[12]

Each textbook, including *Cocker's Arithmetick*, was then given a key number, and each item included in that textbook was copied on a separate card containing the correct key number. These items were classified according to the tentative outline set up and on each card were included the topic under which the item was classified, the major subdivision of the item, and, as further subtopics, its exact description, the pages on which it was found in the textbook, and the amount of space given to it as measured to the nearest five-hun-

[11] Gorman, Frank Herman. *Some Facts Concerning Changes in the Content and Methods of Arithmetic.* Doctor's thesis, University of Missouri, Columbia, 1931. 63 p.

[12] *Twenty-ninth Yearbook of the National Society for the Study of Education.* (Report of Society's Committee on Arithmetic.) Public School Publishing Co., Bloomington, Ill., 1930. 749 p.

dredths of a page. The amount of space given to a topic, referred to in this study as "measured space," is space actually used in presenting the material and does not include blank space which may be found at the bottom of a page on which a certain topic is presented. Thus the measured space in a book will always amount to fewer pages than the numbered pages indicate. If new material was found which could not be classified under the headings on the tentative guide, new headings were added to include them. There were items of content, of course, which were very difficult to classify under one particular heading. In each such instance, it was necessary for the analyst to classify the item under the heading which seemed to be emphasized most, as judged by the context of the item and its surrounding material.

Problems or groups of problems which deal with concrete materials and seem to require some thought in order to determine the process of solution have been called written problems. All other problems have been considered as drill.

In identifying subdivisions of content, special effort has been made to keep separate such items as definitions, uses, tables, rules, proofs, drill problems (with answers and without answers), and the reduction, addition, subtraction, multiplication, and division of whole numbers, decimals, common fractions, and denominate numbers. Explanations with the tables, rules, definitions, or examples are included with the material they attempt to explain, because it seemed impossible to measure separately the amount of space given to many of them.

When the contents of all the books to be analyzed had been transferred to cards in the manner described, the cards were sorted by topics. Master sheets were then developed on which each of the book titles was listed across the top, arranged in chronological order. The line headings, at the left of the page, included all topics found in the books, grouped under major topic headings. Across from each topic, the total number of measured pages of space given to that topic in each book was listed in the column headed by the name of that book.

The master sheet contained hundreds of minor topics, many of which were so closely related as to make it possible at times to combine several under one more comprehensive heading. When this combination of topics was completed, there remained 36 main topics and 54 subtopics dealt with in the textbooks of this period. These were set up in table form showing the actual amount of measured space given in each book to each topic and subtopic.

Since the books vary in size of page and size of type, the measured pages of space given to any particular topic in the various books were not directly comparable. Consequently, in order that such comparisons might be made, it was necessary to convert to standard pages the actual measured pages given to each topic in each book. This was accomplished by converting all page measurements to their equivalent in terms of 400 six-letter word solid pages. For example, if a book had, by actual count of both letters and spaces, an average of 392 six-letter words per page, each page would be an equivalent of .98

of a 400-word page, and a total of 151.45 measured pages in that book would be equal to 148.47 standard pages. In this manner all measured page totals found on the preliminary tables of measured space were transferred to standard pages in a second table (Table I of this report) set up in the same form as the first. In the same manner other materials drawn from the master sheets were first set up in table form showing total measured pages and later transferred to a table showing total standard pages given to various phases of arithmetic.

RESULTS OF THE ANALYSIS

Cocker's Arithmetick—Since the *Cocker's Arithmetick* is not directly comparable with the other books studied in this unit, because it was published nearly a century earlier, it has been considered separately from the others.

The data given for this book on the master sheet were grouped by topics and developed in the same manner as were data from the other books analyzed. They are interesting in several respects and are discussed briefly here for the purpose of giving a general view of the organization and content of the book. Only 18 of the 36 main topics included in the seven books published from 1792 to 1820 are touched upon in this book and only 20 of the 54 subtopics. Changing ideas concerning desirable content of textbooks over a period of years probably accounts for some of the differences in subject matter.

A surprising finding is that only three topics—total fundamental processes in whole numbers, total compound denominate numbers, and proportion—are given approximately 105 pages of standard space, or 60 per cent of the 177.17 400-word pages in the book. Five more topics—total vulgar fractions, total practice, alligation, total partnership, and measures—make up another 25 per cent of the book, while no other topic receives as much as 3 per cent of space. Percentage, which is the topic given the greatest amount of space in later textbooks analyzed in this unit, is given only 2.36 pages, while powers and roots, another topic given considerable space later, is among the topics not mentioned at all in the Cocker text. As might be expected, since there are only half as many topics included in this book as in the later books, most of those which are included are given relatively more space than in the 1792 to 1820 books. The only outstanding exceptions to this are in the cases of decimals and total progression.

Space given to each topic—The seven arithmetics published between 1792 and 1820 are fairly consistent in the topics included. Table I shows the number of standard 400-word pages given to each topic and subtopic, as well as the average and total number of standard pages given to each in all of the books listed.

In Table I the average space given to each topic has been determined by dividing the total measured pages given to the topic by seven, the number of books analyzed. This method has been used consistently, even though in many instances some of the books omit a topic altogether, and thus the average is lowered considerably.

TABLE I. NUMBER OF 400-WORD PAGES GIVEN TO EACH TOPIC IN ARITHMETIC TEXTBOOKS FROM 1790 TO 1820

Topic	Walkingame, Francis, *The Tutor's Assistant*, 1792	Pike, Nicolas, *A New and Complete System of Arithmetic*, 1797	Gough, John, *Practical Arithmetick*, 1801	Pike, Nicholas, *The New Complete System of Arithmetick*, 1807	Pike, S., *The Teachers' Assistant*, 1811	Watson, Thomas, et al., *The Youth's Arithmetical Guide*, 1814	Daboll, Nathan, *Daboll's Schoolmaster's Assistant*, 1820	Average	Subtotals	Totals
Arithmetic symbols	1.08	2.24	.78	.47	.48	.41	.50	.85		5.96
Arithmetic (general aspects)	.25	.38	.10	.09	.05	.09	.09	.15		1.05
Total numeration	2.65	3.13	7.56	2.89	2.33	1.46	2.29	3.19		22.31
Numeration by words and Arabic symbols	2.16	2.62	7.09	2.24	2.33	1.14	2.29	2.84	19.87	
Numeration by Roman numbers	.49	.51	.47	.65	0	.32	0	.35	2.44	
Total fundamental processes in whole numbers	6.08	26.49	21.12	15.71	10.03	11.30	14.40	15.02		105.13
Addition and subtraction of whole numbers	.20	.45	0	.61	.24	0	.27	.25	1.77	
Addition of whole numbers	.59	1.98	4.35	1.12	1.66	2.38	3.02	2.16	15.10	
Subtraction of whole numbers	.39	1.41	2.64	.98	1.14	1.74	1.51	1.40	9.81	
Multiplication and division of whole numbers	.29	.83	0	.61	.24	0	.73	.39	2.70	
Multiplication of whole numbers	2.89	11.71	6.37	5.89	3.23	3.43	5.12	5.52	38.64	
Division of whole numbers	1.72	10.11	7.76	6.50	3.52	3.75	3.75	5.30	37.11	
Total vulgar (common) fractions	7.70	15.81	20.09	14.58	9.22	10.48	11.03	12.70		88.91
Vulgar fractions (general)	5.39	9.86	7.76	10.38	5.23	6.54	7.87	7.58	53.03	
Aliquot parts	.25	1.86	2.23	1.54	.33	.46	.37	1.01	7.04	
Addition of fractions	.49	.96	1.66	.75	1.66	1.10	.82	1.06	7.44	
Subtraction of fractions	.54	.70	2.38	.70	1.19	.96	.82	1.04	7.29	
Multiplication of fractions	.49	1.79	2.59	.70	.38	.64	.78	1.05	7.37	
Division of fractions	.54	.64	3.47	.51	.43	.78	.37	.96	6.74	

TABLE I (Continued)

Topic	Walkingame, Francis, *The Tutor's Assistant*, 1792	Pike, Nicolas, *A New and Complete System of Arithmetic*, 1797	Gough, John, *Practical Arithmetick*, 1801	Pike, Nicholas, *The New Complete System of Arithmetick*, 1807	Pike, S., *The Teachers' Assistant*, 1811	Watson, Thomas, *et al.*, *The Youth's Arithmetical Guide*, 1814	Daboll, Nathan, *Daboll's Schoolmaster's Assistant*, 1820	Average	Subtotals	Totals
Total decimals	5.83	20.48	22.51	14.16	7.03	7.73	8.74	12.35		86.48
Decimals (general)	2.30	13.76	13.87	9.49	3.56	3.89	5.12	7.43	51.99	
Addition of decimals	.34	1.41	2.02	.56	.38	.69	1.24	.95	6.64	
Subtraction of decimals	.15	.77	.98	.33	.24	.50	.50	.50	3.47	
Multiplication of decimals	1.37	1.92	2.69	1.68	1.09	1.51	.87	1.59	11.13	
Division of decimals	1.67	2.62	2.95	2.10	1.76	1.14	1.01	1.89	13.25	
Duodecimals	3.82	3.14	0	1.92	3.52	3.11	1.46	2.42		16.97
Federal money	0	3.20	0	2.57	7.22	.82	4.44	2.61		18.25
Measures (tables and their uses)	8.72	14.91	5.12	7.99	3.18	4.62	6.86	7.34		51.40
Total compound denominate numbers	17.24	47.76	24.85	48.03	29.73	36.74	35.87	34.32		240.22
Compound denominate numbers (general)	0	0	3.16	5.98	0	0	1.24	1.48	10.38	
Addition of compound denominate numbers	2.89	4.61	4.92	3.51	5.27	8.01	4.21	4.77	33.42	
Subtraction of compound denominate numbers	2.25	3.46	1.60	3.20	5.08	7.32	3.11	3.72	26.02	
Multiplication of compound denominate numbers	4.75	6.66	5.18	5.00	3.61	8.19	4.21	5.37	37.60	
Division of compound denominate numbers	1.52	5.89	3.57	3.51	3.94	5.95	4.71	4.16	29.09	
Reduction of compound denominate numbers	5.83	27.14	6.42	26.83	11.83	7.27	18.39	14.82	103.71	
Bills and accounts	0	0	0	.42	0	0	.32	.11		.74

TABLE I (Continued)

Foreign exchange	4.61	6.72	26.19	4.49	6.13	6.04	1.65	7.98		55.83
Total geometric forms	0	54.28	0	0	0	0	7.45	8.82		61.73
Geometric forms (general)	0	13.57	0	0	0	0	.50	2.01	14.07	
Areas of geometric forms	0	15.81	0	0	0	0	1.46	2.47	17.27	
Volumes of geometric forms	0	24.90	0	0	0	0	5.49	4.34	30.39	
Total percentage	34.95	87.17	36.73	49.70	21.47	13.82	25.75	38.51		269.59
Percentage and its application	.64	.96	3.93	.56	.52	.46	.27	1.05	7.34	
Commission, brokerage, and insurance	1.47	3.90	.10	1.78	.52	.41	.78	1.28	8.96	
Insurance	0	6.08	.10	2.43	0	0	.27	1.27	8.88	
Profit and loss	1.23	8.70	5.02	6.97	1.66	2.10	2.97	4.09	28.65	
Discount	5.19	8.32	7.14	3.41	1.71	1.51	1.88	4.17	29.16	
Interest (general)	1.86	12.61	3.67	4.68	1.90	0	2.10	3.83	26.82	
Simple interest	9.02	15.68	9.68	15.52	8.88	8.33	10.93	11.15	78.04	
Simple interest in annuities, etc.	6.22	2.05	1.60	0	.05	0	1.10	1.57	11.02	
Compound interest	5.54	18.05	2.28	8.60	2.28	0	3.89	5.81	40.64	
Compound interest in annuities or pensions in arrears	3.04	8.58	3.21	5.75	3.09	1.01	1.33	3.72	26.01	
Perpetuities or annuities forever	.74	2.24	0	0	.86	0	.23	.58	4.07	
Partial payments	1.62	3.97	.78	1.82	.86	1.01	7.18	2.46		17.24
Ratio	0	2.43	0	0	0	0	0	.35		2.43
Alligation	4.85	6.40	7.71	6.17	3.52	3.43	4.25	5.19		36.33
Proportion	9.11	42.43	31.98	32.96	13.16	18.62	13.18	23.06		161.44
Total partnership	2.55	7.30	5.96	7.43	2.38	3.43	2.75	4.54		31.80
Partnership (general)	.15	1.22	4.61	1.40	.10	.09	.14	1.10	7.71	
Simple fellowship	1.47	3.46	0	3.55	1.14	1.37	1.56	1.79	12.55	
Double fellowship	.93	2.62	1.35	2.48	1.14	1.97	1.05	1.65	11.54	
Longitude and time	0	8.38	0	6.08	0	0	0	2.07		14.46
Total powers and roots	8.82	39.04	12.16	20.29	6.70	7.73	8.37	14.73		103.11
Powers and roots (general)	.15	0	.72	0	.33	0	.14	.19	1.34	
Involution or raising of powers	0	2.30	0	2.01	1.00	1.14	.59	1.01	7.04	
Evolution or extraction of roots	6.96	31.68	5.64	13.93	5.37	5.26	6.95	10.83	75.79	
Uses of square root	1.27	3.46	4.40	2.76	0	1.33	.69	1.99	13.91	
Uses of cube root	.44	1.60	1.40	1.59	0	0	0	.72	5.03	
Total practice	6.23	31.49	24.99	21.22	8.60	7.96	4.39	14.98		104.88
Practice (general)	.10	0	.05	0	0	0	0	.02	.15	
Practice in finding total value of goods when price and quantity are given	6.13	27.78	22.20	20.24	8.60	7.96	4.39	13.90	97.30	

TABLE I (Continued)

Topic	Walkingame, Francis, *The Tutor's Assistant*, 1792	Pike, Nicolas, *A New and Complete System of Arithmetic*, 1797	Gough, John, *Practical Arithmetick*, 1801	Pike, Nicholas, *The New Complete System of Arithmetick*, 1807	Pike, S., *The Teachers' Assistant*, 1811	Watson, Thomas, *et al*, *The Youth's Arithmetical Guide*, 1814	Daboll, Nathan, *Daboll's Schoolmaster's Assistant*, 1820	Average	Subtotals	Totals
Practice in finding price when quantity and total value are given	0	0	0	.61	0	0	0	.09	.61	
Practice in finding quantity that can be bought when price and total value are given	0	.45	0	.37	0	0	0	.12	.82	
Practice by decimals	0	3.26	2.74	0	0	0	0	.86	6.00	
Barter	1.37	3.33	2.90	3.23	1.66	1.51	1.42	2.20		15.42
Tare, tret, cloff, etc.	2.65	2.94	10.45	2.90	3.80	3.80	4.25	4.40		30.79
Imports and exports	0	0	1.66	0	0	0	0	.24		1.66
Total progression	5.64	34.82	9.47	14.08	4.37	4.03	4.94	11.05		77.35
Arithmetic progression	2.60	16.90	4.04	5.66	2.28	2.29	1.92	5.10	35.69	
Geometric progression	3.04	17.92	5.43	8.42	2.09	1.74	3.02	5.95	41.66	
Logarithms	0	2.37	6.31	1.82	0	0	0	1.50		10.50
Position or rule of false	2.60	6.02	0	6.12	2.47	3.16	2.97	3.33		23.34
Permutations and combinations	.54	5.95	0	3.55	.76	1.01	.50	1.76		12.31
Algebra	0	41.73	13.46	0	0	0	0	7.88		55.19
Conic sections	0	11.52	0	0	0	0	0	1.65		11.52
Plane trigonometry	0	13.57	0	0	0	0	0	1.94		13.57
Plane geometry	0	4.86	0	0	0	0	0	.69		4.86
Business forms	0	0	0	0	0	0	1.97	.28		1.97
Miscellaneous written problems	9.56	16.64	12.94	0	4.47	7.82	4.71	8.02		56.14
Other miscellaneous items	0	8.58	.41	0	0	0	0	1.28		8.99
Total 400-word pages	148.47	579.48	306.23	290.69	153.14	160.13	181.73	259.98	1,819.87	1,819.87

The length of book varies a great deal, the shortest text containing only 148.47 standard pages and the longest one 579.48 pages, a difference of more than 430 pages. Although the earliest book, according to date of publication, is also the shortest, there seems to be a tendency in most cases for the later books to be shorter. Each of the three books published in the last ten years of this period is shorter than any of those published between 1797 and 1807.

As a rule, the long books give more space to each topic and contain more topics than the shorter books. There are, however, a sufficient number of exceptions to indicate that the authors had little unanimity of opinion regarding how much space is necessary for the adequate treatment of a topic. For example, in the space given to arithmetic symbols, the average in all books is .85 standard pages, with only two books, the shortest and the longest, exceeding the average. On the other hand, a book containing 153.14 pages devotes almost the same amount of space to this topic as does another book containing 290.69 pages. Again, the second longest book, containing 306.23 pages, devotes 7.09 pages to numeration by words and Arabic symbols, or nearly three times as much as is devoted to this topic in the longest book.

As might be expected, the longest book omits fewer topics than any of the others. This book, Pike's 1797 text, includes all but three of the major topics listed, while the other books omit from 9 to 13 each. In the same text, Pike includes four topics not found in any of the other texts studied and gives to 25 of the 36 major topics at least 25 per cent more than the average amount of space given to each topic by all books. The shortest book gives this much space to only two topics, the next shortest to only one, and Watson's book to none at all. The second longest book gives 25 per cent more than average space to only ten topics and the next longest to only five. The same relationship of size of book to space given to each topic is found when the topics receiving more than 25 per cent less than average space are studied. Excluding the topics that are omitted, the shortest book of the group gives at least 25 per cent less than average space to five different topics, while the next two books in length give it to six topics each. The longest book and the third from longest contain no topics that fall in this category, while the second longest contains only two.

These data seem to indicate that, in general, the longer books not only deal with more topics than the shorter ones, but they also give more space to the topics included. There are, however, a number of exceptions to these generalizations.

Since the textbooks analyzed are of different lengths, the relative emphasis given to a topic by the various texts cannot be readily secured from Table I. For this reason Table II has been developed to show the percentage of space given to each of the topics within each book.

According to Table II, total percentage is emphasized more than any other topic during the period, with total compound denominate numbers being a close second. In order of their importance as judged

TABLE II. PER CENT OF 400-WORD PAGES GIVEN TO EACH TOPIC IN ARITHMETIC TEXTBOOKS FROM 1790 TO 1820

Topic	Walkingame, Francis, *The Tutor's Assistant*, 1792	Pike, Nicolas, *A New and Complete System of Arithmetic*, 1797	Gough, John, *Practical Arithmetick*, 1801	Pike, Nicholas, *The New Complete System of Arithmetick*, 1807	Pike, S., *The Teachers' Assistant*, 1811	Watson, Thomas, et al., *The Youth's Arithmetical Guide*, 1814	Daboll, Nathan, *Daboll's Schoolmaster's Assistant*, 1820	Subtotals	Totals
Arithmetic symbols	.73	.39	.25	.16	.31	.26	.28		.33
Arithmetic (general aspects)	.17	.07	.03	.03	.03	.06	.05		.06
Total numeration	1.78	.54	2.47	.99	1.52	.91	1.26		1.23
Numeration by words and Arabic symbols	1.45	.45	2.32	.77	1.52	.71	1.26	1.09	
Numeration by Roman numbers	.33	.09	.15	.22	0	.20	0	.13	
Total fundamental processes in whole numbers	4.10	4.57	6.90	5.40	6.55	7.06	7.92		5.78
Addition and subtraction of whole numbers	.13	.08	0	.21	.16	0	.15	.10	
Addition of whole numbers	.40	.34	1.42	.39	1.08	1.49	1.66	.83	
Subtraction of whole numbers	.26	.24	.86	.34	.74	1.09	.83	.54	
Multiplication and division of whole numbers	.20	.14	0	.21	.16	0	.40	.15	
Multiplication of whole numbers	1.95	2.02	2.08	2.03	2.11	2.14	2.82	2.12	
Division of whole numbers	1.16	1.74	2.53	2.24	2.30	2.34	2.06	2.04	
Total vulgar (common) fractions	5.19	2.73	6.56	5.02	6.02	6.54	6.07		4.89
Vulgar fractions (general)	3.63	1.70	2.53	3.57	3.42	4.08	4.33	2.91	
Aliquot parts	.17	.32	.73	.53	.22	.29	.20	.39	
Addition of fractions	.33	.17	.54	.26	1.08	.69	.45	.41	
Subtraction of fractions	.36	.12	.78	.24	.78	.60	.45	.40	
Multiplication of fractions	.33	.31	.85	.24	.25	.40	.43	.40	
Division of fractions	.36	.11	1.13	.19	.28	.49	.20	.37	
Total decimals	3.93	3.53	7.35	4.87	4.59	4.83	4.81		4.75
Decimals (general)	1.55	2.37	4.53	3.26	2.32	2.43	2.82	2.86	

TABLE II (Continued)

Addition of decimals	.23	.24	.66	.19	.25	.43	.68	.36	
Subtraction of decimals	.10	.13	.32	.11	.16	.31	.28	.19	
Multiplication of decimals	.92	.33	.88	.58	.71	.94	.48	.61	
Division of decimals	1.12	.45	.96	.72	1.15	.71	.56	.73	
Duodecimals	2.57	.54	0	.66	2.30	1.94	.80		.93
Federal money	0	.55	0	.88	4.71	.51	2.44		1.00
Measures (tables and their uses)	5.87	2.57	1.67	2.75	2.08	2.89	3.77		2.82
Total compound denominate numbers	11.61	8.24	8.11	16.52	19.41	22.94	19.74		13.20
Compound denominate numbers (general)	0	0	1.03	2.06	0	0	.68	.57	
Addition of compound denominate numbers	1.95	.80	1.61	1.21	3.44	5.00	2.32	1.84	
Subtraction of compound denominate numbers	1.52	.60	.52	1.10	3.32	4.57	1.71	1.43	
Multiplication of compound denominate numbers	3.20	1.15	1.69	1.72	2.36	5.11	2.32	2.07	
Division of compound denominate numbers	1.02	1.02	1.17	1.21	2.57	3.72	2.59	1.60	
Reduction of compound denominate numbers	3.93	4.68	2.10	9.23	7.72	4.54	10.12	5.70	
Bills and accounts	0	0	0	.14	0	0	.18		.04
Foreign exchange	3.11	1.16	8.55	1.54	4.00	3.77	.91		3.07
Total geometric forms	0	9.37	0	0	0	0	4.10		3.39
Geometric forms (general)	0	2.34	0	0	0	0	.28	.77	
Areas of geometric forms	0	2.73	0	0	0	0	.80	.95	
Volumes of geometric forms	0	4.30	0	0	0	0	3.02	1.67	
Total percentage	23.54	15.04	11.99	17.10	14.02	8.63	14.17		14.81
Percentage and its application	.43	.17	1.28	.19	.34	.29	.15	.40	
Commission, brokerage, and insurance	.99	.67	.03	.61	.34	.26	.43	.49	
Insurance	0	1.05	.03	.84	0	0	.15	.49	
Profit and loss	.83	1.50	1.64	2.40	1.08	1.31	1.63	1.57	
Discount	3.50	1.44	2.33	1.17	1.12	.94	1.03	1.60	
Interest (general)	1.25	2.18	1.20	1.61	1.24	0	1.16	1.47	
Simple interest	6.08	2.71	3.16	5.34	5.80	5.20	6.01	4.29	
Simple interest in annuities, etc.	4.19	.35	.52	0	.03	0	.60	.61	
Compound interest	2.05	1.48	1.05	1.98	2.02	.63	.73	1.42	
Compound interest in annuities or pensions in arrears	3.73	3.11	.74	2.96	1.49	0	2.14	2.23	
Perpetuities or annuities forever	.50	.39	0	0	.56	0	.13	.22	
Partial payments	1.09	.69	.25	.63	.56	.63	3.95		.95
Ratio	0	.42	0	0	0	0	0		.13
Alligation	3.27	1.10	2.52	2.12	2.30	2.14	2.34		2.00

TABLE II (Continued)

Topic	Walkingame, Francis, *The Tutor's Assistant*, 1792	Pike, Nicoas, *A New and Complete System of Arithmetic*, 1797	Gough, John, *Practical Arithmetick*, 1801	Pike, Nicholas, *The New Complete System of Arithmetick*, 1807	Pike, S., *The Teachers' Assistant*, 1811	Watson, Thomas, *et al.*, *The Youth's Arithmetical Guide*, 1814	Daboll, Nathan, *Daboll's Schoolmaster's Assistant*, 1820	Subtotals	Totals
Proportion	6.14	7.32	10.44	11.34	8.59	11.63	7.25		8.87
Total partnership	1.72	1.26	1.95	2.56	1.55	2.14	1.51		1.75
Partnership (general)	.10	.21	1.51	.48	.07	.04	.08	.42	
Simple fellowship	.99	.60	0	1.22	.74	.86	.86	.69	
Double fellowship	.63	.45	.44	.85	.74	1.23	.58	.63	
Longitude and time	0	1.45	0	2.09	0	0	0		.79
Total powers and roots	5.94	6.74	3.97	6.98	4.38	4.83	4.61		5.67
Power and roots (general)	.10	0	.24	0	.22	0	.08	.07	
Involution or raising of powers	0	.40	0	.69	.65	.71	.32	.39	
Evolution or extraction of roots	4.69	5.47	1.84	4.79	3.51	3.28	3.82	4.16	
Uses of square root	.86	.60	1.44	.95	0	.83	.38	.76	
Uses of cube root	.30	.28	.46	.55	0	0	0	.28	
Total practice	4.20	5.43	8.16	7.30	5.62	4.97	2.42		5.76
Practice (general)	.07	0	.02	0	0	0	0	.01	
Practice in finding total value of goods when price and quantity are given	4.13	4.79	7.25	6.96	5.62	4.97	2.42	5.35	
Practice in finding price when quantity and total value are given	0	0	0	.21	0	0	0	.03	
Practice in finding quantity that can be bought when price and total value are given	0	.08	0	.13	0	0	0	.05	
Practice by decimals	0	.56	.89	0	0	0	0	.33	
Barter	.92	.57	.95	1.11	1.08	.94	.78		.85

TABLE II (Continued)

Tare, tret, cloff, etc.	1.78	.51	3.41	1.00	2.48	2.37	2.34		1.69
Imports and exports	0	0	.54	0	0	0	0		.09
Total progression	3.80	6.01	3.09	4.84	2.85	2.52	2.72		4.25
Arithmetic progression	1.75	2.92	1.32	1.95	1.49	1.43	1.06	1.96	
Geometric progression	2.05	3.09	1.77	2.90	1.36	1.09	1.66	2.29	
Logarithms	0	.41	2.06	.63	0	0	0		.58
Position or rule of false	1.75	1.04	0	2.11	1.61	1.97	1.63		1.28
Permutations and combinations	.36	1.03	0	1.22	.50	.63	.28		.68
Algebra	0	7.20	4.40	0	0	0	0		3.03
Conic sections	0	1.99	0	0	0	0	0		.63
Plane trigonometry	0	2.34	0	0	0	0	0		.75
Plane geometry	0	.84	0	0	0	0	0		.27
Business forms	0	0	0	0	0	0	1.08		.11
Miscellaneous written problems	6.44	2.87	4.23	0	2.92	4.88	2.59		3.08
Other miscellaneous items	0	1.48	.13	0	0	0	0		.49
Total per cent	100.01	100.00	99.98	99.99	99.98	99.99	100.00	99.97	100.00

by the percentage of space given them, the leading major topics are as follows:

Total percentage, 14.81 per cent
Total compound denominate numbers, 13.20 per cent
Proportion, 8.87 per cent
Total fundamental processes in whole numbers, 5.78 per cent
Total practice, 5.76 per cent
Total powers and roots, 5.67 per cent

No other topics are given as much as 5 per cent of the space in all texts combined. Bills and accounts is given the least space of any, with arithmetic (general aspects), imports and exports, ratio, and business forms being next in order.

Only three of the seven books deal with logarithms, and only two treat bills and accounts, geometric forms and their areas and volumes, longitude and time, and algebra. Ratio as separate from proportion, conic sections, plane trigonometry, plane geometry, and business forms are found in only one book each. Foreign exchange is included in all books, but only those books that were published in America deal with federal money.

Few trends can be pointed out positively from Table II. In the earliest textbook almost one fourth of the book is given to percentage, more than twice as much space as is given to any other topic. The emphasis is less pronounced in the next two texts, and from 1807 on, total compound denominate numbers is the most important topic as judged by space allotted to the subject. This would seem to indicate that the study of percentage lost in popularity during the period, while the study of total compound denominate numbers gained.

Proportion is the third most emphasized topic in these books as a whole, and here again the books seem to be fairly consistent, as this topic falls in either second, third, or fourth place in all of the texts. There is not such unanimity of opinion in regard to total fundamental processes in whole numbers, which falls fourth in emphasis in all books combined. The two earliest books place this topic in ninth place, but it steadily becomes of increasing importance until in the 1820 text it falls in third place.

The various books disagree as to the emphasis to be given to total powers and roots. The 1801 book ranks this topic as eleventh in importance, the 1807 book puts it fourth, and the 1811 book drops it to ninth place.

To arithmetic symbols and the general aspects of arithmetic, the two least important (as judged by amount of space given) of the topics included in all books, the earliest text gives much more space than do any of the others. In the other six books, the variation from greatest to least space given the second of these topics amounts to only .04 per cent.

On the whole, the percentages in Table II show a rather remarkable consistency in relative emphasis given to the various topics. Some books, as has been pointed out before, omit a number of topics, but this fact has not greatly affected the relation to each other of those that are included.

Space given to each type of content—In addition to major divisions of content in arithmetic, there are also certain aspects of treatment which are common to many different topics or divisions. Table III shows the amount of standard space given in each book to such aspects as rules, definitions, examples, and problems.

Since it was almost impossible to classify some of the material under one type of treatment only, some of the content has been included under more than one heading in Table III. For example, combined reduction (general) includes definitions, rules, examples, and problems which have also been listed under these specific headings but which deal with some phase of reduction.

For this reason the total number of pages listed under each book amounts to more space than the book measures. The first ten topics, however, do not overlap each other, but they do include materials also found in one or more of the last ten topics.

As might be expected, the longest book (Pike's 1797 edition) gives more space than any of the other books to definitions, tables, rules, examples, multiplication, and division. On the other hand, however, four shorter books give more space to combined addition and five shorter ones give more space to combined subtraction than the longest book. It should be called to the attention of the reader here that the topics addition, subtraction, multiplication, and division in this table include those processes only where they have been set forth separately as such in the texts. Thus they do not include all practice in these processes which the pupil would derive in studying the textbook. More specifically, for example, combined addition includes addition of whole numbers, fractions, decimals, denominate numbers, etc., only when set forth in the texts under the heading addition. Examples of proof and their explanation, and combined topics on uses are types of content not found in the four textbooks published after 1801. This does not mean that no such material occurred in these books. Instead, examples of proof are so combined with the examples of solution as to make it difficult to separate them for the purpose of measurement. Comments on uses are similarly combined with explanations of definitions, tables, and rules. In other words, examples of proof and uses no longer remain as distinctly separate topics.

Pike's 1797 text is the only one of the seven which includes written problems without answers and the only one which includes all types of content listed. As might be expected because of its length, this book usually gives more space to the different types of material than do the others. Of the 20 types of content, 13 are given more space here than in any of the other books, examples and their explanations being given as much as 100 pages more here than in the other texts. In only one instance, that of drill problems with answers, is this book the lowest of the seven in number of pages used.

The shortest book, on the other hand, gives the fewest pages of any of the texts to as many as 8 of the 20 types of content. Watson's book omits 8 of the types, thus presenting only 12 kinds of material.

Here again, the relative emphasis given the different types of material cannot be discovered readily from data concerning the meas-

TABLE III. NUMBER OF 400-WORD PAGES GIVEN TO EACH TYPE OF CONTENT IN ARITHMETIC TEXTBOOKS FROM 1790 TO 1820*

Type of Content	Walkingame, Francis, *The Tutor's Assistant*, 1792	Pike, Nicolas, *A New and Complete System of Arithmetic*, 1797	Gough, John, *Practical Arithmetick*, 1801	Pike, Nicholas, *The New Complete System of Arithmetick*, 1807	Pike, S., *The Teachers' Assistant*, 1811	Watson, Thomas, *et al.*, *The Youth's Arithmetical Guide*, 1814	Daboll, Nathan, *Daboll's Schoolmaster's Assistant*, 1820	Total	Average
Definitions and their explanations	5.93	22.02	11.70	14.77	4.89	6.86	8.37	74.54	10.65
Tables and their explanations	11.42	45.63	11.75	26.97	12.40	9.61	10.80	128.58	18.37
Rules of proof and their explanations	.88	.77	.62	.51	1.14	1.10	.69	5.71	.82
Rules and their explanations	24.06	120.64	53.46	56.33	26.22	18.39	35.59	334.69	47.81
Examples of proof and their explanations	.05	.26	1.04	0	0	0	0	1.35	.19
Examples and their explanations	28.42	223.04	79.59	122.11	31.73	21.78	52.93	559.60	79.94
Drill problems without answers	5.15	13.63	12.47	9.68	6.08	0	9.42	56.43	8.06
Drill problems with answers	20.04	15.81	26.08	18.19	19.90	28.09	24.89	153.00	21.86
Written problems without answers	0	.38	0	0	0	0	0	.38	.05
Written problems with answers	45.47	46.53	83.73	28.38	43.23	69.77	35.73	352.84	50.41
Combined reduction (general)	13.43	41.41	32.24	37.54	16.86	16.38	26.44	184.30	26.33
Reduction ascending	.15	1.02	.67	.14	.43	0	.41	2.82	.40
Reduction descending	.59	1.09	.57	.89	.24	0	.59	3.97	.57
Combined topics on uses	.39	4.80	1.09	0	0	0	0	6.28	.90
Combined joint addition and subtraction topics	.20	.45	3.36	6.59	.24	0	1.51	12.35	1.76
Combined joint multiplication and division topics	.29	.83	0	.61	.24	0	.73	2.70	.39
Combined addition	4.17	9.22	12.94	6.26	9.93	11.71	10.93	65.16	9.31
Combined subtraction	3.33	6.53	8.64	5.38	8.74	10.57	7.18	50.37	7.20
Combined multiplication	12.69	24.64	18.11	15.01	11.02	15.83	11.67	108.97	15.57
Combined division	5.39	19.84	18.58	13.37	11.35	11.62	9.97	90.15	12.87

* Some of the material in these textbooks has been included under more than one heading. For this reason the total number of pages listed for each book amounts to more than the number of pages in the book.

ured space given each, and therefore Table IV has been developed, giving the percentage of space allotted in each text to each kind of content.

According to Table IV, more emphasis is placed upon examples and their explanations than upon any other type of material in the seven books combined, as well as in the Walkingame, Gough, and Daboll arithmetics individually. In all four of the other books written problems with answers, the second most important type in the books combined, is given more stress than any other kind of content. There is a great deal of consistency in giving emphasis to the various aspects of treatment. Each of the four types given most space in the seven books combined falls within the first five in importance in each of the books separately. These four types, in order of importance in the combined group of texts, are as follows:

Examples and their explanations, 30.75 per cent
Written problems with their answers, 19.39 per cent
Rules and their explanations, 18.39 per cent
Combined reduction (general), 10.13 per cent

Less space is given to written problems without answers than to any other type of content, but this type appears in only one book. Of the types appearing in each of the seven books, less emphasis is given to rules of proof and their explanation than to any of the others.

Few trends are evident in the stressing of certain types of content throughout the period, for on the whole there is not much difference between the early books and the later ones. Combined subtraction, combined addition, and combined division are given more space in books appearing in 1811, or later, than in the earlier books, while tables and their explanations are given less space. Examples of proof and their explanations, written problems without answers, and combined topics on uses do not appear as such in any book published after 1801. This does not mean, however, that these types are given no space at all, for in many cases the material is included in a book but is so interwoven with other types of content that it cannot be accurately separated.

Since in the general order of content within the books definitions come first and, with the occasional exception of tables, rules immediately follow, it can be seen from the final column of Table IV that, on the average, no more than 5 per cent of the content of any subject unit precedes the statement of the rule. (Incidentally, explanations of definitions and of rules almost invariably follow the concise statements concerning them. Neither the definition nor the rule is the climax of explanatory material.) Similarly, in these books, since examples immediately follow the rules, an average of from 25 to 30 per cent of the material on any subject unit in these texts precedes the example.

Altogether, approximately 31 per cent of the combined content of the texts is devoted to problems to be solved. Of this amount, a total of nearly 12 per cent is devoted to drill problems either with or without answers, and almost 20 per cent to written problems of application either with or without answers. Definitions, tables, rules,

TABLE IV. PER CENT OF 400-WORD PAGES GIVEN TO EACH TYPE OF CONTENT IN ARITHMETIC TEXTBOOKS FROM 1790 TO 1820

Type of Content	Walkingame, Francis, *The Tutor's Assistant*, 1792	Pike, Nicolas, *A New and Complete System of Arithmetic*, 1797	Gough, John, *Practical Arithmetick*, 1801	Pike, Nicholas, *The New Complete System of Arithmetick*, 1807	Pike, S., *The Teachers' Assistant*, 1811	Watson, Thomas, *et al.*, *The Youth's Arithmetical Guide*, 1814	Daboll, Nathan, *Daboll's Schoolmaster's Assistant*, 1820	Combined books
Definitions and their explanations	3.99	3.80	3.82	5.08	3.19	4.28	4.61	4.10
Tables and their explanations	7.69	7.87	3.84	9.28	8.10	6.00	5.94	7.07
Rules of proof and their explanations	.59	.13	.20	.18	.74	.69	.38	.31
Rules and their explanations	16.21	20.82	17.46	19.38	17.12	11.48	19.58	18.39
Examples of proof and their explanations	.03	.04	.34	0	0	0	0	.07
Examples and their explanations	19.14	38.49	25.99	42.01	20.72	13.60	29.13	30.75
Drill problems without answers	3.47	2.35	4.07	3.33	3.97	0	5.18	3.10
Drill problems with answers	13.50	2.73	8.52	6.26	12.99	17.54	13.70	8.41
Written problems without answers	0	.07	0	0	0	0	0	.02
Written problems with answers	30.63	8.03	27.34	9.76	28.23	43.57	19.66	19.39
Combined reduction (general)	9.05	7.15	10.53	12.91	11.01	10.23	14.55	10.13
Reduction ascending	.10	.18	.22	.05	.28	0	.23	.15
Reduction descending	.40	.19	.19	.31	.16	0	.32	.22
Combined topics on uses	.26	.83	.36	0	0	0	0	.35
Combined joint addition and subtraction topics	.13	.08	1.10	2.27	.16	0	.83	.68
Combined joint multiplication and division topics	.20	.14	0	.21	.16	0	.40	.15
Combined addition	2.81	1.59	4.23	2.15	6.48	7.31	6.01	3.58
Combined subtraction	2.24	1.13	2.82	1.85	5.71	6.60	3.95	2.77
Combined multiplication	8.55	4.25	5.91	5.16	7.20	9.89	6.42	5.99
Combined division	3.63	3.42	6.07	4.60	7.41	7.26	5.49	4.95

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examples and their explanations, and written and drill problems altogether occupy a total of 91.61 per cent of the space in the seven books published from 1790 to 1820. This means that less than 8 per cent of the total space is given to general discussions and other forms of arithmetic content.

Analysis of problem subjects—One of the most interesting phases of the analysis of arithmetic texts is the analysis of the problem subjects—the items about which the concrete problems are made—because a frequency tabulation of the various items mentioned in written problems indicates, in general, the degree of correlation of arithmetic with life interests, activities, and relationships during the period in which the textbooks were written. Such an analysis is designed to determine: (1) to what extent the pupils during any specific period have been given at least implied, if not direct, training in matters of practical economic and social relationships; (2) to what extent the authors have made use of the economic and sociological conditions about them in selecting and compiling the written problems for the texts; and (3) to what extent the arithmetic problems have been correlated with other interests.

As the quantitative analysis of space given to various phases of arithmetic content was made, a few of the outstanding types of problem subjects found in each book were also noted on cards. These were grouped under more comprehensive headings which were classified in still larger divisions according to their nature.

Lists were also made of such problem subjects as occupations, kinds of cloth and clothing, metals and alloys, foods and farm products, and sample price quotations, as well as of interesting problems and unique expressions which throw some light on the customs of the times in which the books were published.

In classifying the problem subjects, such things as tare and tret, federal money, and foreign exchange are not given detailed attention here, since they are treated in the general quantitative space analysis. The headings under which all subjects included in the analysis are grouped are classified as to their socio-economic significance. Those headings which could be classified as economic or sociological in implication or fact are included in divisions dealing with economic subjects, sociological subjects, or socio-economic subjects (those which might be listed in either category but cannot be classified positively under either division separately). All other headings are included in a miscellaneous division. Since it is recognized that it is often difficult to determine whether a problem subject, such as wages, for example, is purely economic or whether it is related more specifically to sociological effect, any classification of subjects must necessarily be an arbitrary one, which might not always agree with a classification made by someone else. In order that there might be less variation in this phase of our analysis it seems desirable for us to come to an agreement on the definition of terms involved.

As a working basis, sociology has been defined as that study "whose subject matter relates directly to the organization and development of human society, and to man as a member of social groups."[13]

[13] Dunn, Arthur W. *The Social Studies in Secondary Education.* U.S. Bureau of Education Bulletin, No. 28, Washington, D.C., 1916, p. 9.

As a corollary, sociological conditions would be conditions having their origin in the organization and development of society or in the relationship of men in social groups. For the same purpose, economics has been defined as that study which "deals with the production, exchange, possession, consumption, and use of material goods and immaterial services."[14] Economic conditions, then, would be those conditions having their origins in these phases of group activity; and practical economics would include economic problems and conditions closely related to everyday living.

With these concepts in mind, Table V has been developed, giving the number of times each of the subjects listed is found in the written problems in each of the books in the period from 1797 to 1820.

In Table V the frequency of mention of each subject and the total frequency of mention in all seven books are given.

Indebtedness is the economic subject most often used in written problems, being included 124 times; shipping and seamen is next in frequency, followed in order by barter, labor, area content, estate, tobacco, and distance. No other subject is used more than 41 times. Mint and pensions are used only once each, while auction, apprenticeship, and mill are included twice each. Of the 40 main economic subjects listed in the table, from 9 to 22 are omitted in each book. Walkingame's book, the earliest to be published in the group, contains the fewest subjects, while the *Practical Arithmetic* by Gough contains the largest number.

Only six socio-economic subjects are listed. Of these, military situations, travel, and wages are mentioned 53 or 54 times each, while none of the other three is mentioned more than 14 times. Gough's text contains all of the subjects, while Pike's 1807 text and Daboll's include only the three leading ones. Education is of minor importance as judged by frequency of mention.

Of the sociological subjects, beverages is mentioned far more often than any other, wine alone being mentioned 122 times and brandy 40 times, while no other subject is used more than 24 times. Cistern. recreation, moral issues, dowry, and candles are next in order of frequency of mention. Hospital and inn are included only once each. Pike's 1797 text includes all but 5 of the subjects, while his 1807 book omits 12, the largest number omitted in any of the texts.

The miscellaneous subjects used in written problems include time (used 59 times), age determination, history, the planetary system, and shadows, in the order named. Walkingame's book includes no problems dealing with the planetary system or shadows, and the book by S. Pike contains none dealing with history. All the other books include all subjects listed in this general classification.

The total number of problem subjects tabulated in each book ranges from 263 in Pike's 1807 text to 498 in Gough's arithmetic. Most of these subjects are either economic, socio-economic, or sociological, as only from 4 to 11 per cent fall in the miscellaneous group. Many of the topics in this miscellaneous group, however, are also of a very practical nature, such as age determination, history, and time.

Economic subjects are mentioned far more often than any other kind listed, being named in most books two or three times as often

[14] Bowley, A. L. *The Mathematical Groundwork of Economics.* Oxford University Press, London. 1924. p. 1.

TABLE V. FREQUENCY OF MENTION OF PROBLEM SUBJECTS IN ARITHMETIC TEXTBOOKS FROM 1790 TO 1820

Problem Subjects	Walkingame, Francis, *The Tutor's Assistant*, 1792	Pike, Nicolas, *A New and Complete System of Arithmetic*, 1797	Gough, John, *Practical Arithmetick*, 1801	Pike, Nicholas, *The New Complete System of Arithmetick*, 1807	Pike, S., *The Teachers' Assistant*, 1811	Watson, Thomas, *et al.*, *The Youth's Arithmetical Guide*, 1814	Daboll, Nathan, *Daboll's Schoolmaster's Assistant*, 1820	Total
Economic Subjects								
Acreage	2	0	2	3	6	23	5	41
Apprenticeship	0	0	0	0	1	1	0	2
Area content (papering, painting, carpeting, cloth lining, cellar digging, etc.)	28	4	3	3	16	18	13	85
Auction	0	0	2	0	0	0	0	2
Bankruptcy	0	2	1	2	1	3	1	10
Barter	13	12	16	10	18	17	12	98
Building	0	1	1	2	0	0	1	5
Carriage of loads	7	0	8	0	4	3	4	26
Clocks	0	1	5	1	0	1	2	10
Distance	5	9	10	5	5	11	7	52
Estate	20	9	12	4	4	13	10	72
Federal debt	0	2	0	1	0	0	2	5
Grants	0	0	2	0	0	0	2	4
Guardian	0	0	2	0	2	2	0	6
Income	9	4	0	1	3	10	2	29
Indebtedness (loan, borrow, etc.)	24	16	15	13	15	25	16	124
Insurance (including insurance of shipping)	0	11	2	2	0	1	3	19
Labor	8	6	10	10	26	19	10	89
Latitude and longitude	0	4	6	2	0	2	3	17
Lease	13	4	6	0	2	0	2	27
Legacy	6	4	5	2	1	6	2	26
Lighthouse	0	3	1	0	0	0	0	4
Mill	0	2	0	0	0	0	0	2
Mint	0	0	0	0	0	0	1	1
Orchards	0	3	0	0	3	2	1	9
Pasture	0	1	1	2	1	3	4	12
Pensions	0	0	1	0	0	0	0	1
Plate (silver) service	1	1	1	0	1	5	7	16
Privateers	2	1	1	1	0	0	4	9
Prize money and lottery	4	1	1	1	0	1	9	17
Rations								
Animal	2	1	1	0	1	1	0	6
Army	3	1	1	1	0	1	0	7
Family	0	0	0	0	1	1	1	3
Men	0	0	0	0	2	7	0	9
Rent	8	3	7	2	1	0	4	25

TABLE V (Continued)

Problem Subjects	Walkingame, Francis, *The Tutor's Assistant*, 1792	Pike, Nicolas, *A New and Complete System of Arithmetic*, 1797	Gough, John, *Practical Arithmetick*, 1801	Pike, Nicholas, *The New Complete System of Arithmetick*, 1807	Pike, S., *The Teachers' Assistant*, 1811	Watson, Thomas, *et al.*, *The Youth's Arithmetical Guide*, 1814	Daboll, Nathan, *Daboll's Schoolmaster's Assistant*, 1820	Total
Shipping and seamen	6	28	17	11	8	16	14	100
Storm at sea	0	1	4	3	0	3	1	12
Student expenses	2	0	1	0	0	1	0	4
Taxes	1	1	0	1	0	1	2	6
Tayloring	1	2	2	2	1	1	1	10
Tobacco	19	7	15	4	6	5	4	60
Wheels								
Carriage or wagon wheels	0	2	1	2	0	0	2	7
Water-wheels	0	0	2	0	0	1	0	3
Wood (logwood, timber, cord-wood, etc.)	0	4	1	0	0	1	6	12
***Socio-Economic Subjects**								
Charities	3	4	1	0	4	2	0	14
Education	3	1	2	0	2	4	0	12
Financial maintenance of family	0	0	1	0	0	3	0	4
Military situations and references	9	15	8	7	3	7	5	54
Travel (walking, stage, post, etc.)	6	14	5	5	8	8	8	54
Wages (salaries)	15	4	5	3	11	9	6	53
Sociological Subjects								
Bell-ringing	2	2	0	0	1	0	0	5
Beverages								
Ale	1	1	0	1	0	0	0	3
Beer	4	2	0	2	2	2	2	14
Brandy	0	7	17	3	1	5	7	40
Cider	0	1	2	1	3	2	2	11
Rum	1	4	3	0	0	2	5	15
Wine	12	14	31	6	13	30	16	122
Bible	0	1	4	0	1	2	2	10
Candles	4	2	0	1	0	1	0	8
Castles	1	0	0	0	1	0	0	2
Cistern	0	7	1	7	3	0	6	24
Dowry	3	1	1	1	1	2	0	9
Holiday	0	1	3	0	0	1	0	5
Hospital	1	0	0	0	0	0	0	1
Inn	0	1	0	0	0	0	1	2
Library	1	0	0	0	0	0	0	1
Marriage	0	1	0	0	0	2	0	3
Medicine	1	0	0	0	1	2	0	4

TABLE V (Continued)

Problem Subjects	Walkingame, Francis, *The Tutor's Assistant*, 1792	Pike, Nicolas, *A New and Complete System of Arithmetic*, 1797	Gough, John, *Practical Arithmetick*, 1801	Pike, Nicholas, *The New Complete System of Arithmetick*, 1807	Pike, S., *The Teachers' Assistant*, 1811	Watson, Thomas, *et al.*, *The Youth's Arithmetical Guide*, 1814	Daboll, Nathan, *Daboll's Schoolmaster's assistant*, 1820	Total
Moat	2	0	0	0	0	0	0	2
Moral issues (gambling; stealing sheep, apples, etc.; finding and keeping money; wasting fortune, etc.)	44	1	4	0	0	0	2	11
Recreation (adventure, toys, etc.)	5	3	8	2	2	0	2	22
Miscellaneous Subjects								
Age determination	12	8	10	4	10	11	1	56
History (current and past)	1	7	7	7	0	5	5	32
Planetary system	0	7	8	4	2	8	2	31
Shadow of height of steeple, pole, tower, etc.	0	1	5	1	1	3	1	12
Time								
Time (in general)	2	10	3	7	4	14	2	42
Time from birth of Christ	3	3	3	2	0	4	2	17
Total Economic Subjects	279	213	366	199	309	267	227	1860
Total Socio-Economic Subjects	36	38	22	15	28	33	19	191
Total Sociological Subjects	42	49	74	24	29	51	45	314
Total Miscellaneous Subjects	18	36	36	25	17	45	13	190
Grand Total	375	336	498	263	383	396	304	2604
Number of Standard Pages of Written Problems	45.47	46.91	83.73	28.38	43.23	69.77	35.73	353.22
Average of Times Each Economic, Socio-Economic, or Sociological Subject is Mentioned on Each Page of Written Problems	7.9	6.4	5.5	8.4	8.5	5.0	8.1	6.7

* Those topics which could not be classified definitely as economic or as sociological and yet which were closely related to both were classified as socio-economic.

as all the others put together. Economic, socio-economic, and sociological topics are mentioned from 5.0 to 8.5 times per standard page of written problems in these textbooks. If this is to be used as an indication of the practicality of these books, *The Teachers' Assistant*, by S. Pike, would be considered the most practical, with N. Pike's

1807 book a close second, as these books mention such subjects 8.5 and 8.4 times, respectively, per standard page of written problems. Watson's book includes such subjects only 5.0 times and Gough's 5.5 times per page.

In all books combined, these subjects are mentioned an average of 6.7 times per 400-word page of written problems, 5.3 of these being in the field of economics alone. These figures suggest that arithmetic problems in texts published even as early as the beginning of the nineteenth century were based on useful, everyday subjects.

Detailed subjects—A more detailed analysis of some of the data summarized in Table V brings to light much interesting information about the times. In connection with many of the socio-economic items, a number of measures used during the latter part of the eighteenth and early part of the nineteenth centuries were found. Though commonly used 150 years ago, many of these measures disappeared long ago from common use. The following list is typical of the measures then used, as indicated in the textbooks examined:

Bales of velvet	Hogsheads of tallow	Stones of wool
Barrels of beef	Jars of Lacca Oil	Stones of wheat
Barrels of pork	Fodder of lead	Tierces of rice
Chaldrons of coals	Pipes of wine	Tun of cheese
Chests of sugar	Quintal of fish	Tun of wine
Hogsheads of sugar	Nails of cloth	A yard and hide of land

Sample price quotations found in these early texts are interesting when studied in relation to prices today, although, of course, the purchasing power of the dollar must be taken into consideration before any true comparisons can be made. A few of these quotations follow:

Almonds.....37½¢ per lb.	Men's shoes ..... $1.51 pair
Beef ..... 4¢ per lb.	Paper ..... $2.35 per ream
Butter ..... $7.14 per firkin (8 gal. per firkin)	Pineapple ..... 33⅓¢ apiece
	Pork ..... 8¢ per lb.
Cheese ..... 8¢ per lb. (1820)	Potatoes ..... 56¼¢ per bu.
Coffee ..... 21¢ per lb.	Oats ..... 33¢ per bu.
Corn ..... 87½¢ per bu.	Quills ..... 11 s. per 1000
Flour ..... $8.00 per bbl.	Ribbon ..... 18¾¢ per yd.
Green tea ..... 15¢ per lb.	Satin ..... $3.75 per yd.
Hay ..... $20.78 per ton	Watermelon ..... 25¢ each
Hog's lard ..... 15¢ per lb.	Worsted hose .... $1.04 per pair
Land ..... $14.67 per acre	

The relative cost of various items in this period is especially interesting. For example, beef at 4¢ per lb. and pork at 8¢ as compared with corn at 87½¢ a bushel and hay at $20.78 a ton is at considerable variance with the present ratio between consumer costs of these commodities. Apparently most of the prices in this list are typical of the prices of these commodities about the year 1800. On the whole, however, the prices of commodities varied considerably even within each text. This variation indicates either that prices of some products fluctuated widely or that the authors of the books frequently

set prices arbitrarily in order to vary the problems. Perhaps both situations occurred.

Some of the occupations followed at the beginning of the nineteenth century, as mentioned in the arithmetic texts of that period, also throw light on the life of the period. Presumably these were occupations with which the people were commonly acquainted, and in all probability they include the major vocations followed. Many of these, such as butcher, farmer, grocer, merchant, and mechanic, are still common today. On the other hand, such vocations as chaise-maker and cooper have almost entirely ceased to exist. Such terms as "lace-man," "corn factor," and "goose girl" are certainly not in common use today, though the tasks may still be performed under different titles. The terms "plummer" and "oyl-man" are old forms of spelling used during the period studied, but in some of the books present-day spellings of such terms are also found. The following are the chief occupations discovered by the analysis:

apothecary
army positions
artificer
auditor of fire-office
baker
banker
brewer
butcher
butler
carrier
chaise-maker
chapman
clerk
coach-maker
confectioner
cooper
corn chandler
corn factor
country gentleman
courier
draper
druggist
factor
farmer
gamester
goldsmith
goose-girl
grazier
grocer
guardian
hatter
jeweller
jockey
journeyman
lace-man
landlord
maltster
manufacturer
master
mealman
mechanic
mercer
merchant
merchant's clerk
messenger
nobleman
oyl-man, or oilman
plummer, or plumber
press-gang
refiner
scavenger
scholar
schoolmaster
searcher
servant
shoemaker
shop-keeper
silversmith
stationer
store-keeper
tallow-chandler
taylor, or tailor
thresher
tobacconist
trader
tutor
userer
vintner
wharfinger
wine merchant

The kinds of cloth and articles of clothing mentioned in problems in arithmetic texts published from 1790 to 1820 are also interesting. No doubt they are materials and articles with which the elite at least were well acquainted. Since some of the authors state, as one of their objectives, that they have attempted to prepare arithmetics to serve those engaged in commerce, it is reasonably certain that the materials mentioned were actually bought and sold during that period. It is assumed, therefore, that all of the types of cloth and articles of clothing mentioned in these early texts were in use at that time. Many of the items, such as "serge," "silk," "shoes," and "hose," are still in common use today. On the other hand, such items as "dowlas," "lustring" or "lutestring," "sarsanet," "say," and "shalloon" have long ago ceased to appear in everyday retail trade.

The analysis of the written problems in these early textbooks yields the following list of cloths and clothing:

baize
ballandine silk
bay-yarn
beaver hats
black mode
broadcloth
brocade
buttons
calico
camblet
cambric
dimity
cambrick
canvas
carpeting
cassimere
check
chintz
cloak
cloth
coating
damask
diaper
dimity
dowlas
drugget
Flanders lace
flannel
German serge
Ghentish cloth
gloves
hats
Holland cloth
hose
inkle
Irish cloth
Irish linen
kerseys
lawn
linen
lustring, or lutestring
mantua
muslin
nankeen, or nankin
plush
ribbon, and riband
saffron
sarsanet
satin
say
scarlet drab
serge
shalloon
shoes
silk
skeins of worsted
stockings
stuff
superfine cloth
tabby
tape
tapestry
thread
velvet

Numerous written problems in the early texts also made use of alcoholic beverages, indicating either a wider use of such at that time, or a lack of strong sentiment against their use, or both. Certainly they were common products in trade in the late eighteenth and early nineteenth centuries. The analysis yields the following list:

ale
beer
brandy
cider
liquor
mead
rum
shrub
wines:
Canary, Cicilian, claret, Flemish, French, Lisbon, Madeira, mountain, port, sherry, white

Next to kinds of cloth and clothing, foods and farm products as a group seem to have been mentioned most frequently in problems of application in those arithmetics published between 1790 and 1820. The following is a list of the foods and products referred to in the seven books analyzed:

almonds
anchovies
apples
bacon
barley
beef
bread
butter
cheese
cherries
chestnuts
chocolate
cider
cinnamon
cloves
cocoa
cod-fish
coffee
corn
cornmeal
cotton
currants
eggs
figs
fish
flax
flaxseed
flour
ginger
grass
ham
hay
herrings
hides
hops
lard
loaf sugar
mace
madder
malt
molasses
nutmegs
oats
onions
oranges
peaches
pears
pepper
pineapples
plums, or plumbs
pork
potatoes
prunes
raisins
rice
rye
salmon
salt
spice
sturgeon
sugar
sugar plums
tallow
tea
tobacco
watermelons
wheat
white biscuit
wool

While not all items in the above list are foods nor are they all farm products, it was thought best to combine them into one list. Some farm products, such as apples, bacon, and corn, are foods for man; some such as corn, oats, wheat, and rye are used as foods for both man and farm animals; such products as grass and hay are used as food only for farm animals; while still others such as cotton, wool and hides, and tobacco, are representative of the non-food products. Madder was cultivated extensively until after the dye which it produced was produced artificially in the latter part of the nineteenth century. Fish are included among the foods, as are non-alcoholic drinks such as coffee and tea and condiments such as mace, cloves, ginger, and nutmegs. Presumably most of the foods in the list were commonly found on the tables of those people living in England, Ireland, and America at the time that these early arithmetics were written, and the remaining foods were used by at least a sufficient number of families to make them important in commerce and trade.

Since the authors of these arithmetic textbooks of a century and a half ago avowedly aimed toward serving the needs of merchants, very few problems of application were made about animals. With few exceptions, the animals mentioned are those which seemed to have the greatest commercial value at that time. The snail (a mollusk) is mentioned in an identical problem in two books. The list of animals found in these texts is as follows:

calves	geese	mules	snails
cattle	horses	oxen	steers
cows	lambs	sheep	

Metals and alloys receive a great deal of attention in the written problems of this period. They are mentioned especially with relation to transportation and to the making of metal articles and are sometimes used in problems concerning prices, weights, and volumes. In all probability, the metals and alloys referred to in these problems are those actually used in industry at that time. The following is a list of those found in the books analyzed:

alloy	gold	lead	pewter	silver bullion
copper	iron	mercury	quicksilver	steel

The chief metal articles mentioned are:

bells	horse shoes	pins	silver globe
bullets	nails	pipes	silver wire
cannon balls	pen knives	rings	watch

The items of household equipment and supplies referred to are probably those used near the beginning of the nineteenth century. These also include metal articles. The majority of the items listed are commonly found in homes today, but a few, such as quills, porringers, and snuff boxes, are no longer used to any extent.

cabinet of drawers
candles
carpeting
casters
chest of drawers
clocks
cups
knives
porringers
punch bowl
quills
salts (gold and silver)
salvers
seats
silver bowls
silver dishes
silver forks
silver lamps
silver porringers
silver snuff boxes
silver table spoons
silver teakettle
shagreen case for silver ware
soap
tankards (gold and silver)
tapestry
teaspoons (gold and silver)
vessels (containers)
wall paper
water tub

A number of references made to building materials and construction work indicate the types of construction produced or existing during the period. The analysis yields the following list:

boat
brickwork
bridge
castle wall
cellar
cistern
cornice
courtyard
edifice
fence
flooring
glazing
house
moulding
painting
partitions
pavement
plastering
purbeck stone
rafters
roof pitch
roofing
tiling
wainscoting
walls

In the problems of these early arithmetic texts very few references are made to the education of youth. The following items, however, throw some light on educational practice 150 years ago:

Arithmetic
copy book
English reader
English reader: Introduction
English reader: Sequel
pupil
pupil's board
pupil's tuition
scholar
scholar's need of library
school
schoolmaster
slate
slate pencil
tutor

A brief survey of this list reveals the limitations of the school curriculum and facilities of the period. The mention of the terms tutor, board, and tuition calls to mind private instruction and the practice of employing a private tutor to prepare pupils for entering secondary boarding schools. Readers and arithmetics and the copybook and slate provide the means for learning "the 3 R's," then recognized as the only essentials of the elementary school program.

The references to transportation and travel give a picture of the modes of travel during these early years. The chief ones mentioned are:

boat
cargo of a vessel
carriage
chaise
chariot
coach
ferry
footman
horseback
ship
ship bread
sloop
vessel
wagon

Since the Revolutionary War occurred only shortly before these texts were published and the War of 1812 took place during the period studied, it is not surprising that there are many military references found in these early arithmetics. The chief references are:

army
army hospitals
battalions
besieged town
bullets
cannon ball
colonel
flash of a piece of ordnance
garrison
general
marching columns
officers
plundered city
powder
prisoners of war
private men
provisions for army
rank and file
regiments
soldiers
squadrons of horses

Several historical references are also found in the written problems of the texts published near the beginning of the nineteenth century. These no doubt represent some of the chief historical interests of the period. Typical of these references are:

Babylon taken by Cyrus
Battle of Lexington
Birth of Christ
Birth of King George III
Birth of Washington
Building of London
Calling of Abraham
Capture of Burgoyne
Capture of Earl Cornwallis
Commencement of Christian Era
Declaration of Independence
Discovery of America
Grants made by the Crown
Invention of compass
Invention of gunpowder
Invention of printing
Irish "Happy" Revolution of 1688
Massacre at Boston by British troops
National debt of England
Post dispatch
Press gangs
Reformation period
Restoration in 1660
Revolutionary War
Romulus founding Rome
Salary of Prince of Wales
Time from creation of world to flood
War between England and America

These detailed lists of items mentioned in written problems in the arithmetics analyzed give a comprehensive picture of the scope and nature of the problem subjects used during the first period covered in this study. Contrary to popular opinion, the written problems in early texts were applied to the practical life situations and interests of the day. Since agriculture, crafts, and coastwise and foreign trade were the most prominent vocations in that day, the activities themselves and the articles produced and transported received the greatest emphasis in arithmetic problems. Dress, food, and general living conditions of that period are also common subjects of problems as indicated by these lists.

Further relations of these arithmetic problems to the life of the day are shown by the terms, phrases, and clauses dealing with economics of the home, insurance, population, transportation, business transactions, craft industry, and occupations. The following classified economic references are typical of those mentioned:

Dress—

Beaver hats
Lady purchased damask for gown

Food—

If 4 men in 5 days eat 7 lb. of bread.....
Man and his wife found that a bushel of meal would last them just two weeks

Health—

Spent life gaming and ruined health

Human relations—

Gentleman in his will leaves 50 £. to the poor, 1/3 to ancient men, 1/4 to poor women, 1/5 to poor boys, 1/6 to poor girls
If I lent my friend 34 £. for 5/8 of year.....
Four graziers hold pasture in common

Living conditions—

Use of candles
Use of quills
Gentleman's service of plate
Ignorant fop wanting to buy an elegant house
Man overtaking a maid driving a flock of geese, "How do you do, Sweetheart, how many geese do you have in your flock?"
Young scholar, coming into town for convenience of good library, demands what lodging and diet will cost.

Morals—

Spent life gaming
A, B, and C, being a little dipped, drove a poor bargain
Stealing of sheep
Stealing of apples
Finding purse and keeping money
Wasting a fortune
Gambling

National progress—

Number of inhabitants in United States = 5 millions
Discoveries—Printing, gunpowder, compass, America
Reformation

Recreation—

Counting and dividing chestnuts
Country fair
Dinner for knights, merchants, citizens, lawyers, etc.
Gaming
May pole
Playing cards
Scuffle for sugar plums
Sum of money for "nine months" adventure
Play with tops

Social customs—

Spectators' Club of Fat People
Men's Clubs
Gentlemen met at inn, and were so well pleased with the host and with each other that they agreed to tarry
Use of snuff boxes
Sumptuous funeral and monuments
Gentleman bought chaise, horses, and harness
Primogeniture

Likewise, the sociological aspects of the life of the times are shown by terms, phrases, and clauses dealing with dress, food, health, human relations, living conditions, morals, national progress, recreation, and social customs. The following classified sociological references are typical of those mentioned:

Economics of the home—

Use of candles
Silver plate in care of butler

Building features: wainscoting, shutters, courtyard, cornice, and moulding
Purchase of set of plate—porringers, tankards, cups, salts, etc.

Insurance—

Children's Leagues
Relief for life
Guardianship for minors

Population—

Population of United States
An island contains 75 countries, each country 45 parishes, each parish 324 houses, and each house 9 persons

Transportation—

Distance: Dublin to Cork, Newburyport to Boston, etc.

Business transactions—

Purchase of a West-Indian sloop
Estates, fortunes
A man's sister, heiress-at-law
Dowry
Loans
Scavenger's note from rent assessment
Continental tax
Federal money
Barter
Barter tracts of land
Bought at auction
Legislature of a state grant tax of 8 mills on dollar
Ten pounds a quarter allowed to 5 auditors of fire-office. They attend about 7 times in the quarter and absentees money divided equally among those attending.
A gentleman, calculating the expenses of his two sons for board, tuition, etc., at school
Paying of customs, porterage, cellarage, cooperage, lighterage
Cost of logwood
Paying of wharfage, primage, etc.
Forms for a bill of sale, short will, obligatory bond, lease of a house, note payable at bank, inland bill of exchange, promissory note
Rule in some parishes to assess the inhabitants in proportion to 8/10 of their rents. What is yearly rent of that house which pays 8 £. 10 s. to King under the limitations?
Wages of soldiers or servants

Craft, industry, and occupation—

Silversmith received ingots of silver with directions to make them into spoons, cups, snuff boxes, etc.
Water-wheel problems
Light-house references
Press-gang—warrant to press
Hire a clerk by covenant
An indented apprentice engaged to serve 7 years
Pioneers cast a trench
Men trench a field
Laborers salting down carcasses of beef in barrels
Granary problems
Farmer driving cattle to market
Farm laid out in form of a square, to be enclosed with a post and rail fence

Unusual problems—The concrete subjects about which written problems found in the books analyzed were made to show a definite

relationship to the economic and sociological conditions of the time at which they were published—the period from 1790 to 1820. Commercial topics are predominant; many problems are related to vocational topics; and a number of problems deal with insurance. Simple business forms such as notes, wills, bonds, bills of exchange, bills of sale, and leases are found in some of the books. English money is treated in all the textbooks analyzed for this unit; federal money and state currency, in all of the texts published in the United States, but not in those books published in England and Ireland. Foreign money is treated in all texts except the one by Gough, which was published in Ireland. Thus, it is evident that there was a definite attempt on the part of the authors of these early texts to provide arithmetic content which would serve a practical purpose, although they did include a number of impractical problems, a few puzzle problems, and several problems related to historical fácts.

From the problems included in these early books, a considerable number of historical facts could be gleaned, even if no other history of the period were available. From them, a fairly accurate picture of home life and human relations during the period can be gained. The problems, as a whole, are definitely built around the living conditions, moral standards, recreational activities, habits of dress, social customs, and general interests of the day as the authors saw and knew them.

Written problems in these early arithmetic texts may be classified in a number of different ways. They may be divided into groups of practical, impractical, and puzzle problems, and they may be appropriately classified as economic, sociological, socio-economic, and historical.

In making a distinction between practical and impractical problems, one must consider them in relation to the day in which they were written, not in terms of the present. The large quantities used in some problems might be considered impractical in so far as average individual needs are concerned and yet such quantities may have been approached in coastwise and foreign trade. Since such commerce was a major interest in this early period and since some of the books were avowedly written to assist those engaged in trade, it may have been practical to give the scholars a great deal of experience in handling larger numbers. On the other hand, there are a number of problems in these early books which seem unquestionably impractical. The following are examples of the impractical:

> How many minutes are there from the time of Christ to the present?
>
> How many inches are there from Boston to New York?
>
> How many seconds old are you at 16 years?
>
> How long will it take to count a million at 50 per second?
>
> Suppose 144 oranges were laid 2 yards distant from each other in a straight line, and a basket placed two yards from the first orange, what length of ground will they travel over, who gathers them up singly, returning with them one by one to the basket?
>
> How many barley corns will reach from Newbury to Boston, it being 43 miles?
>
> The Spectator's Club of fat people, though it consisted of but 15

persons, is said to weigh no less than three tons; how much at an equality was that per man?

Practical problems may be considered as those involving situations encountered in everyday living, such as buying, selling, and shipping. A few examples of problems which may be classified as practical are:

A man having 50 s. to pay amongst his labourers for a day's work, would give to each boy 6 d., to any woman 8 d., and to every man 16 d. The number of boys, women, and men was the same. I demand to know the number of each.

If the Legislature of a State grant a tax of 8 mills on the dollar, how much must that man pay who is 319 dollars, 75 cents on the list?

Sold 895 acres of land, at 2 £. 18 s. 6 d. per acre, what is the value?

How much muslin, 1 1/4 yd. wide, will be necessary to line 18 3/4 yards of silk, 3/4 yd. wide?

What will 250 1/3 bushels of wheat come to, at 145 4/5 cts. per bushel?

The determination of puzzle problems is a highly subjective procedure. They may be defined as problems stated in such a way as to be purposely confusing, often containing data which are useless in cbtaining the answer or presenting the data in an unusual order. In the book by Cocker only three such problems were found and in the seven texts published between 1790 and 1820 only 74 were discovered. This number is very small when compared to the total number of problems found in these texts. The following are a few examples of these puzzle problems:

A lady was asked her age, who replied thus:
My age, if multiplied by three,
Two-sevenths of that product tripled be;
The square root of two-ninths of that is four—
Now tell my age, or never see me more.

When first the marriage-knot was ty'd
Between my wife and me,
Her age did mine as far exceed
As three times three does three;
But when seven years, and half seven years
We man and wife had been,
My age came then as near to hers
As eight is to sixteen.
What was each of our ages when we married?

The silk mill at Derby, England, contains 26,586 wheels, and 97,746 movements, which wind off or throw 73,726 yards of silk every time the great water-wheel, which gives motion to the rest, goes about, which is three times in a minute; how many yards of silk may be thrown by this machine in a day, reckoning 10 hours to a day's work, and how many in a year, deducting for Sundays and holidays 63 days, provided no part of it stands still?

A tract of land is to be laid out in form of an equal square, and to be enclosed with a post and rail fence 5 rails high, so that each rod of fence should contain 10 rails. How large must this noble square be to contain just as many acres as there are rails in the fence that encloses it, so that every rail shall fence an acre?

Many problems which may be classified as practical, impractical, and even puzzle may also be considered as economic or sociological, or both. Any problems dealing with buying and selling, banking, insurance, taxes, and the like are economic. The following are examples:

Bought cloth at $1 1/4 a yard, and lost 25 per cent. How was it sold a yard?

In 276 barrels of raisins, each 3 1/2 cwt., how many hundred weight?

What cost 45 oxen, at 8 £. per head?

A gentleman left his son a fortune, 1/4 of which he spent in three months; 3/7 of the remainder lasted him 10 months longer, when he had only 252 dollars left; pray what did his father bequest him?

The number of the inhabitants in the United States is five million; now suppose each should pay the trifling sum of 5 cents a year, for the term of twelve years, towards a continental tax, how many dollars would be raised thereby?

Some problems are chiefly sociological in implication, as:

In a Gentleman's Service of plate there are 14 dishes weighing 16 lb. 10 oz. 13 dwt; 36 Plates weighing 36 lb. 10 oz. 11 dwt; 6 Salts weighing 2 lb. 8 oz; Knives and Forks, 6 lb. 11 oz. 9 dwt; 4 Salvers, 9 lb. 5 oz. 4 dwt; Cups, Tankards, 22 lb. 18 dwt; a Silver Tea-Kettle and Lamp, 10 lb. 6 oz. 9 dwt. What quantity of Plate had the Butler under his care?

A person said he had 20 children, and that it happened there was a year and a half between each of their ages; his eldest son was born when he was 24 years old, and the age of his youngest is 21; what was the father's age?

If 3 gallons of brandy be the allowance of 8 men for 12 days, what will be the allowance of 10 men for 16 days?

Charles was bound to an apprentice for 7 years. He has served 2 years, and 5 months. How long has he still to serve?

Many problems nearly equally emphasize economic and sociological aspects of life and are termed socio-economic. Some of these are:

What did that gentleman receive in dowry with his wife, whose fortune was her wedding suit; her petticoat having two rows of furbelows, each furbelow 87 quills, and each quill 21 guineas?

Hetty told her brother George that though her fortune on her marriage took 19,312 pounds out of her family, it was but 3/5 of two years rent, heaven be praised! of his yearly income; pray, what was that?

A person willing to distribute some money among a number of beggars, wanted 8 d. to give them 3 d. a piece; he therefore gave each 2 d. and had 3 d. left; how many beggars were there?

Problems containing historical references are such as these:

How long is it since the Happy Revolution (Irish) which happened in the year 1688; we are now in the year 1786?

How many minutes since the commencement of the Christian Era, allowing it to be 1797 years?

George Washington was born in 1732; what is his age in 1787?

Gen. Burgoyne and his army were captured October 17th, 1777, and Earl Cornwallis and his army, October 19th, 1781: What space of time between?

America was discovered by Columbus in 1492 and its Independence declared in 1776; How many years have elapsed between those two eras?

Many interesting, unique, and obsolete expressions are found in the statement of problems. A view of the psychology of teaching in that day is to be found in the use of such expressions as "I demand the answer," and "I demand to know." These are evidences of the stern discipline of the day and the reverence in which the schoolmaster was held. Such obsolete forms as "pray, how many" and "pray, tell the answer" are also frequently found.

Other unusual uses of words or expressions are commonly found. "How much did it stand by me?" means "How much did I have?" "I demand to know how much I have by me" means "How much do I have?"

"Agio" is a term used to signify the difference between bank and current money. "Facit" is used for "answer." "Promiscuous" examples are review problems based on various parts of the book. "Neat," "net," and "nett" weight are all the same. "Tare," "tret," "cloff," and "suttle" are practical rules for deducting allowances. As was the custom in those days, the word "scholars" is used to mean pupils; pioneers "cast" a trench instead of dug a trench; a "grass enclosure" is a pasture; "horse in his furniture" is a harnessed horse; "flitches of bacon" are sides of bacon; three men "companied" instead of forming a partnership; an "ancient" lady means an old lady; the farmer "mingleth" wheat and barley, means he mixed them; and the term "cattle" includes horses and hogs as well as cows. Many of these terms have become obsolete today, while others are purely colloquial.

The poetic tendency is shown in the preface to *Cocker's Arithmetick* in this verse:

Seven Sciences supremely excellent,
Are the chief stars in Wisdoms Firmament,
Whereof Arithmetick is one, whose worth
The Beams of Profit and Delight shines forth;
This crowns the rest; this makes man's mind compleat;
This treats of Numbers, and of this we treat.

In order to make learning easier, some of the problems and rules were stated in verse. An example of one of the rules which has survived is as follows:

30 days hath September,
April, June, and November,
All the rest hath 31
Except that short month, February, alone
Which to itself claims but 8 and a score
But in every leap year we give it one more.

Rules for subtraction, multiplication, division, least common multiple, reduction of fractions, finding value of fraction, cube root, and others are given in verse in the various books.

Any number of problems are written in verse, many of them

being greatly lengthened in statement because of this. The following three examples are typical:

Just sixteen yards of German serge,
For ninety dimes had I
How many yards of that same cloth
Will fourteen eagles buy?

In the Year I wrote this, if to my Age you add
1/2, 1/8, 1/5 (thereof) with 4/5 more,
The Number 74 will then be had,
Ingenious youths, my age explore.

A castle wall there was, whose height was found
To be an hundred feet from th' top to th' ground;
Against the wall a ladder stood upright
Of the same length that the castle was in height.
A waggish youth did the ladder slide
(The new bottom of it) ten feet from the side:
Now I would know how far the top did fall,
By pulling out the ladder from the wall?

As stated by some of the authors, the books are an attempt to present the science of numbers. In preparing them, an effort was made to simplify the science so that the processes might be understood readily by the novice. Accuracy and skill in solving the problems according to set rules are emphasized. Except in a few promiscuous or miscellaneous problems, the choice of the right operation is not required. Definitions, rules, and examples with solution are given and problems to be solved are classified under these rules. Thus, the solving of most of the problems included is chiefly mechanical. It is necessary for the pupil to be able to read and understand the explanations and the statements of the problems, but there are no specific provisions for simple mental exercises or oral problems.

These general characteristics provide an interesting picture of the aims and purposes of teaching arithmetic, the psychology back of the teaching, and some of the major interests of the day. Together with the study of the problem subjects and with the emphasis on phases of content, they provide a composite picture with which to compare subsequent units.

SUMMARY AND GENERAL CONCLUSIONS

The analysis of textbooks published before 1820 has brought forth a number of interesting and enlightening facts concerning the teaching of arithmetic at that time. The conclusions drawn from this analysis are as follows:

1. Most of the textbooks analyzed are bound in leather. The printed pages are small, most of them about 3 by 5½ inches. The type is usually small, and considerable space is left between topics on many of the pages.

2. *Cocker's Arithmetick*, which was published nearly 100 years earlier than any of the other texts studied and therefore has been considered separately from the seven books published between 1790 and 1820, includes only half of the main topics found in the other books and not much more than one third of the subtopics. More

than 60 per cent of the space in this book is given to three topics—total fundamental processes in whole numbers, total compound denominate numbers, and proportion.

3. The seven books published in the first period considered in this analysis vary a great deal in length—from 148.47 to 579.48 standard 400-word pages. The general tendency is for the later books to be shorter.

4. The texts are fairly consistent in the topics considered, and present them in approximately the same order, that is, whole numbers, vulgar fractions, decimals, duodecimals, and questions.

5. Most problems are accompanied by answers at the end of each problem statement. Pike's text is the only one of the group that includes written problems without answers.

6. The content of each book is presented by the deductive method.

7. There is a lack of uniformity in the use of some of the terms and signs. For example, the comma is sometimes used for the decimal point, and the period is used for setting off thousands, millions, etc.

8. The general order of treatment of each topic is as follows: definition, rule with explanation, often a brief rule of proof, example with explanation, sometimes an example of proof, drill problems, and written problems.

9. As a rule, the longer books give more space to each topic and contain more topics than the shorter books.

10. The general make-up of the textbooks, especially in such things as tables, is very different from that of modern textbooks.

11. In all texts combined, total percentage is given more space than any other topic, followed in order by total compound denominate numbers, proportion, total fundamental processes in whole numbers, total practice, and total powers and roots. No other topic is given more than 5 per cent of space. Ratio (as separate from proportion), conic sections, plane trigonometry, plane geometry, and business forms are included in only one book each.

12. Foreign exchange is included in all books published in the United States.

13. The study of percentage is given as much as one fourth of the space in the earliest text of the period, but became less popular in later books, while the study of total compound denominate numbers increased in popularity during the period.

14. Examples of proof and their explanation, and combined topics on uses are types of content not found in the four textbooks published after 1801.

15. On the average, no more than 5 per cent of the content of any phase of subject matter precedes the rule, and from 25 to 30 per cent of the material on each phase precedes the example.

16. Approximately 31 per cent of the content of the combined textbooks is devoted to problems, of which about 20 per cent are written and 11 per cent are drill problems.

17. In all books combined, economic, socio-economic, and sociological subjects are mentioned on an average of 6.7 times on each standard page of written problems. Of the major groupings of problem

subjects 40 were economic subjects, 6 were socio-economic subjects, 16 were sociological subjects, and 5 were miscellaneous subjects.

18. Of the economic subjects, indebtedness is used most often, followed in order by shipping and seamen, barter, labor, area content, estate, tobacco, and distance. No other subject is mentioned more than 41 times in all the books. Military situations, travel, and wages are the three most frequently mentioned socio-economic subjects. Beverages are mentioned much more frequently than any other subject that is classified as sociological.

19. In several of the books, the Latin word "facit" is used for "answer" and "agio" is a term used to signify the difference between bank and current money.

20. Many obsolete expressions, such as "laid out in market" (paid for), "horse in his furniture" (harnessed horse), "cast" (dug), "flitches of bacon" (sides of bacon), and "companied" (formed a partnership) are used.

21. Many unusual and now obsolete measures, occupations, and kinds of cloth, food, and other products are mentioned.

22. Prices, as given in these problems, vary considerably from present-day prices.

23. Some rules and problems are stated in verse, but comparatively few (less than 75 altogether) puzzle problems are included.

24. Many of the problems throw some light on the living conditions, moral standards, recreation, dress, and social customs of the period. References to educational matters reveal the limitations of the school curriculum and facilities of the period.

25. The problems are stated with apparently no effort to solicit child interest.

26. Since examples and problems are classified under specific rules, pupils are often not required to choose the correct mental process to be used in solving a problem.

27. Problem subjects show a definite relationship to the economic and sociological conditions of the day. Commerce, vocations, business, and insurance serve as bases for problems. Problems seem to have been prepared with the purpose of providing a practical preparation for adulthood.

A List of Bulletins in the Field of Education, Indiana University

By KATHLEEN DUGDALE

The School of Education at Indiana University has published the following bulletins. All of these may be obtained from the University Bookstore for 50 cents postpaid unless otherwise noted.

Proceedings of the High School Principals' Conference (November 23 and 24, 1923). Vol. I, No. 1, 1924. 85 p. (Supply exhausted.)

Investigation of Nursing as a Professional Opportunity for Girls, Part I, Technical Study; Part II, Vocational Information Bulletin. By Florence E. Blazier. Vol. I, No. 2, 1924. 69 p.

Proceedings of the Eleventh Conference on Educational Measurements. Vol. I, No. 3, 1925. 141 p.

Proceedings of the High School Principals' Conference (November 14 and 15, 1924). Vol. I, No. 4, 1925. 49 p. (Supply exhausted.)

First Revision of the Bibliography of Educational Measurements. Compiled by the Bureau of Cooperative Research. Vol. I, No. 5, 1925. 147 p. (Supply exhausted.)

Proceedings of the Twelfth Conference on Educational Measurements. Vol. I, No. 6, 1925. 76 p.

The Effect of Population upon Ability to Support Education. By Harold F. Clark. Vol. II, No. 1, 1925. 28 p.

Proceedings of the High School Principals' Conference (November 20 and 21, 1925). Vol. II, No. 2, 1925. 77 p. (Supply exhausted.)

A Cross-Indexed Bibliography on School Budgets. By Harold F. Clark. Vol. II, No. 3, 1926. 66 p.

A Comparison of the Results Made on Certain Standardized Tests by Pupils in the Bloomington High School Who Were Taught in Classes of the Same Grade by University Student Teachers and by Regular High School Teachers. By Carl G. F. Franzén. Vol. II, No. 4, 1926. 19 p.

Proceedings of the Thirteenth Annual Conference on Educational Measurements. Vol. II, No. 5, 1926. 103 p.

When to Issue School Bonds. By Harold Florian Clark and Paul Royalty. Vol. II, No. 6, 1926. 16 p.

Students' Attitude Toward Examinations. By Grover T. Somers. Vol. III, No. 1, 1926. 48 p.

Proceedings of the High School Principals' Conference (November 12 and 13, 1926). Vol. III, No. 2, 1926. 27 p.

Index Numbers in School Administration. By Harold F. Clark. Vol. III, No. 3, 1927. 35 p.

Topical Analysis of 234 School Surveys. Compiled by the Bureau of Cooperative Research. Vol. III, No. 4, 1927. 111 p. (Supply exhausted.)

Proceedings of the Fourth Annual Conference on Elementary Supervision. Vol. III, No. 5, 1927. 64 p.

Proceedings of the Fourteenth Annual Conference on Educational Measurements. Vol. III, No. 6, 1927. 66 p.

Some Phases of the Junior College Movement. By I. Owen Foster, Harold F. Clark, Willard W. Patty, and Leo M. Chamberlain. Vol. IV, No. 1, 1927. 125 p. (Supply exhausted.)

Second Revision of the Bibliography of Educational Measurements. By Henry Lester Smith and Wendell William Wright. Vol. IV, No. 2, 1927. 251 p. (75¢)

Bibliography of School Buildings, Grounds, and Equipment, Part I. By Henry Lester Smith and Leo Martin Chamberlain. Vol. IV, No. 3, 1928. 326 p. (75¢)

Proceedings of the High School Principals' Conference (November 18 and 19, 1927). Vol. IV, No. 4, 1928. 54 p.

The Economic Effects of Education. By Harold F. Clark. Vol. IV, No. 5, 1928. 39 p.

Proceedings of the Fifteenth Annual Conference on Educational Measurements. Vol. IV, No. 6, 1928. 73 p.

Proceedings of the Fifth Annual Conference on Elementary Supervision. Vol. V, No. 1, 1928. 54 p.

Proceedings of the High School Principals' Conference (November 16 and 17, 1928). Vol. V, No. 2, 1928. 33 p.

The Development and Use of a Composite Achievement Test. By Wendell William Wright. Vol. V, No. 3, 1929. 90 p.

An Analysis of the Attitudes of American Educators and Others Toward a Program of Education for World Friendship and Understanding. By Henry Lester Smith and Leo Martin Chamberlain. Vol. V, No. 4, 1929. 109 p.

Tentative Program for Teaching World Friendship and Understanding in Teacher Training Institutions and in Public Schools for Children Who Range from Six to Fourteen Years of Age. By Henry Lester Smith and Sherman Gideon Crayton. Vol. V, No. 5, 1929. 54 p.

Proceedings of the Sixteenth Annual Conference on Educational Measurements. Vol. V, No. 6, 1929. 96 p.

Proceedings of the Sixth Annual Conference on Elementary Supervision. Vol. VI, No. 1, 1929. 73 p.

An Analysis of the Duties of County School Superintendents and Superintendents of Schools in Certain Cities in Indiana. By Henry Lester Smith and Leo Martin Chamberlain. Vol. VI, No. 2, 1929. 94 p.

Proceedings of the High School Principals' Conference (November 22 and 23, 1929). Vol. VI, No. 3, 1930. 51 p.

Cooperative Studies in Secondary Education. By Henry Lester Smith and Carl G. F. Franzén. Vol. VI, No. 4, 1930. 121 p.

Proceedings of the Seventeenth Annual Conference on Educational Measurements. Vol. VI, No. 5, 1930. 103 p.

Proceedings of the Seventh Annual Conference on Elementary Supervision. Vol. VI, No. 6, 1930. 102 p.

A Study in Teacher Supply and Demand in Indiana. By I. Owen Foster, Robert K. Devricks, Harry N. Fitch, Earl C. Bowman, and George L. Roberts. Vol. VII, No. 1, 1930. 77 p.

Proceedings of the High School Principals' Conference (November 7 and 8, 1930). Vol. VII, No. 2, 1930. 70 p.

The Philosophy of Human Relations: Individual and Collective—A Source Book. By Henry Lester Smith and Harold Littell. Vol. VII, No. 3, 1931. 326 p. (75¢)

The Psychology of Human Relationships: Individual and Social—A Source Book. By Henry Lester Smith and Levi McKinley Krueger. Vol. VII, No. 4, 1931. 107 p.

Proceedings of the Eighteenth Annual Conference on Educational Measurements. Vol. VII, No. 5, 1931. 83 p.

Efficiency in College Management. By John Dale Russell. Vol. VII, No. 6, 1931. 143 p.

Bibliography of School Surveys and of References on School Surveys. By Henry Lester Smith and Edgar Alvin O'Dell. Vol. VIII, Nos. 1 and 2, 1931. 212 p. (75¢)

Proceedings of the Nineteenth Annual Conference on Educational Measurements. Vol. IX, No. 1, 1932. 139 p.

Bibliography of School Buildings, Grounds, and Equipment—Part II. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. IX, No. 2, 1933. 182 p.

Bibliography of School Buildings, Grounds, and Equipment—Part III. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. IX, No. 3, 1933. 130 p.

A Brief Summary of Literature on Leadership. By Henry Lester Smith and Levi McKinley Krueger. Vol. IX, No. 4, 1933. 80 p.

Proceedings of the Twentieth Annual Conference on Educational Measurements. Vol. X, No. 1, 1933. 98 p.

Bibliography of College and University Buildings, Grounds, and Equipment. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. X, No. 2, 1934. 199 p. (75¢)

Factors Affecting the Organization of School Attendance Units. By Raleigh Warren Holmstedt. Vol. X, No. 3, 1934. 32 p.

The Old World Historical Background of Religious and Moral Education in Schools. By Henry Lester Smith, Robert Stewart McElhinney, and George Renwick Steele. Vol. X, No. 4, 1934. 144 p.

Proceedings of the Twenty-first Annual Conference on Educational Measurements. Vol. XI, No. 1, 1934. 96 p.

Bibliography of School Buildings, Grounds, and Equipment—Part IV. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. XI, No. 2, 1935. 216 p.

A Brief Survey of Present-Day Religious and Moral Education in the Schools of Countries Other Than the United States of America. By Henry Lester Smith, Robert Stewart McElhinney, and George Renwick Steele. Vol. XI, No. 3, 1935. 185 p.

Some Practical Efforts to Teach Good Will. By Henry Lester Smith and Peyton Henry Canary. Vol. XI, No. 4, 1935. 169 p.

Proceedings of the Twenty-second Annual Conference on Educational Measurements. Vol. XII, No. 1, 1935. 97 p.

A Basis for the Improvement of Education in Rural Monroe County, Indiana. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. XII, No. 2, 1936. 168 p.

Reading Readiness—A Prognostic Study. By Wendell William Wright. Vol. XII, No. 3, 1936. 46 p.

Proceedings of the Twenty-third Annual Conference on Educational Measurements. Vol. XII, No. 4, 1936. 60 p.

Bibliography of Literature on the Teaching of English. By Henry Lester Smith and William Isaac Painter. Vol. XIII, No. 1, 1936. 299 p.

Bibliography of Literature on Education in Countries Other Than the United States of America. By Henry Lester Smith and William Isaac Painter. Vol. XIII, No. 2, 1937. 341 p. (75¢)

Character Development through Religious and Moral Education in the Public Schools of the United States. By Henry Lester Smith, Robert Stewart McElhinney, and George Renwick Steele. Vol. XIII, No. 3, 1937. 137 p.

Proceedings of the Twenty-fourth Annual Conference on Educational Measurements. Vol. XIII, No. 4, 1937. 100 p.

Bibliography of Literature on Education in Countries Other Than the United States of America (January 1, 1919, to December 31, 1924). By Henry Lester Smith and William Isaac Painter. Vol. XIV, No. 1, 1937. 139 p.

Two Studies in Education. By Henry Lester Smith and Merrill Thomas Eaton. Vol. XIV, No. 2, 1938. 42 p.

Bibliography of School Surveys and of References on School Surveys (Supplement to Vol. VIII, Nos. 1 and 2). By Henry Lester Smith and Edgar Alvin O'Dell. Vol. XIV, No. 3, 1938. 144 p. (75¢)

Proceedings of the Twenty-fifth Annual Conference on Educational Measurements. Vol. XIV, No. 4, 1938. 37 p.

Remedial Instruction in Reading with College Freshmen. By Nila Banton Smith. Vol. XV, No. 1, 1938. 35 p.

Two Studies in Arithmetic. By Henry Lester Smith and Merrill Thomas Eaton. Vol. XV, No. 2, 1939. 91 p.

The Relation of Retention to Speed of Learning. By Henry Lester Smith and Merrill T. Eaton. Vol. XV, No. 3, 1939. 105 p.

Proceedings of the Twenty-sixth Annual Conference on Educational Measurements. Vol. XV, No. 4, 1939. 53 p.

An Experimental Study of Standards for the Selection of Candidates for Teacher-Training Institutions. By Henry Lester Smith and Merrill Thomas Eaton. Vol. XVI, No. 1, 1939. 72 p.

State Control of Public School Finance. By Raleigh Warren Holmstedt. Vol. XVI, No. 2, 1940. 71 p.

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Twenty-eighth Annual Conference on Educational Measurements. Vol. XVII, No. 3, 1941. 42 p.

Legal Relations of Pupils and Parents to the Public Schools of Indiana—Part I. By Henry Lester Smith and R. Foster Scott. Vol. XVII, No. 4, 1941. 81 p.

Legal Relations of Pupils and Parents to the Public Schools of Indiana—Part II. By Henry Lester Smith and R. Foster Scott. Vol. XVII, No. 5, 1941. 72 p.

A Study of Students Transferring from Indiana University. By Merrill T. Eaton. Vol. XVII, No. 6, 1941. 26 p.

An Analysis of Arithmetic Textbooks (First Period—1790-1820). By Henry Lester Smith and Merrill T. Eaton. Vol. XVIII, No. 1, 1942. 55 p.